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ABSTRACT

Prepared as part of an effort by Oakland Community College (OCC) to monitor the evolution of information technology in relation to the college's mission and purpose, this report describes OCC's current programs in data processing, examines the fit between the current curriculum and the employment market for computer specialists in southeast Michigan, reviews the literature on technology trends, and presents recommendations. Following introductory material, the report describes OCC's four data processing programs: business computer programming, computer systems analysis, computer science technology, and small computer systems technology. The next section examines employment and educational indicators, including gross projections of computer employment at the federal and regional levels; content analyses of want-ads and of computer specialist offerings at other postsecondary institutions; a review of model curriculum offerings from national computer service organizations; and results from surveys of former data processing students and area employers. Next, a summary is presented of major findings from a literature review of trends in computer technology. The final sections present recommendations for a new computer information science curriculum and for a computer system to support the new curriculum. Appendixes contain: (1) information on OCC's current data processing curriculum; (2) a report on the demand for computer programmers and systems analysts in Michigan; (3) results of the want-ad survey; (4) an analysis of computer course offerings; (5) a more detailed report on the former student and employer surveys, including the survey instruments; and (6) a review of the literature on desktop power, networks, open systems, and software productivity. (JMC)

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Computer Specialist Need Assessment for Oakland Community College - Final Report

October, 1989

Henry Austin, PhD
Principal Investigator

JC 890 471

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Reference Technique

The bibliography is in alphabetic sequence by author name, with a sequence number assigned to each reference. Bibliographic citations within the body of the report are by reference sequence number within parentheses; ie. (10) is a citation to the tenth entry in the bibliography.

References to the appendices of the report are by appendix letter and sometimes page number , also enclosed in parenthesis; ie. (A:3) would be a citation to the third page in appendix A.

Combination references to both the bibliography and appendices contain the bibliographic citation first followed by the citation to the appendix; ie (12, D:3-5) would be a citation to the 12th reference in the bibliography and the third page through fifth pages in appendix D.

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Introduction and background

Introduction: Computer technology presents a moving target for instruction on the application of that technology to human purpose. Computer technology evolves at such a rapid pace that institutions offering instuctional programs utilizing this technology are constantly challenged to keep up. The rewards for keeping pace are first, a good fit between the need for educated computer specialists and the graduates of computer specialists degree programs; second, meeting the societal expectation of computer literacy for an increasing number of job positions and finally, the application of a powerful tool to the instructional process itself. The penalties for falling behind are antiquated job specialist programs and missed opportunities for raising the quality and efficiency of instruction.

Oakland Community College is attempting to keep pace by instititutionalizing a process for monitoring the evolution of information technology, assessing this technology in terms of the mission and purpose of the institution and adapting itself to incorporate those aspects of information technology selected as beneficial to this mission and purpose. The report that follows represents a small beginning in this attempt.

Background: OCC has been meeting service area needs for computer specialist education for over twenty years. Like many of its sister community colleges, OCC is faced with updating its computer specialist education programs. The current focus on batch application software development on stand-alone mainframe computers and application package use on stand-alone MS-DOS PC computers is fast becoming obsolete. Both the trade and scholarly literatures suggest that that computer technology is rapidly evolving in the direction of distributed systems with communication links between PC workstations and mainframe data depositiories.

At a meeting in the spring of 1987 instigated by Mike Crow, Dean of instruction for the Orchard Ridge campus and college co-ordinator for computer instruction, the combined faculties of the DPR/OIS programs suggested an assessment process to examine service area needs in light of the predicted trends in computer technology towards linked multi-level systems. It was further agreed by the faculty that the need assessment effort should include:

1. A formal literature review.
2. MESC labor market computer specialist job projections.
3. Content analysis of local advertisements for computer specialists.
4. An examination of computer specialist instructional programs offered by sister community colleges and bachelor-level institutions.
5. Follow-up survey of DPR program ex-students.
6. Survey of potential computer specialist employers in the OCC service area.

The need assessment project was approved by Dan Jaksen, Orchard Ridge campus president, and the college research council. The author was contracted as principle investigator for the project by the research council.

Current OCC programs in data processing

OCC currently offers a variety of programs related to computers, including equipment repair, computer-aided design (CAD), computer-aided manufacturing (CAM), computer integrated manufacturing (CIM), Office Information Systems (OIS) and data processing (DPR). The primary focus of this study is on the data processing program, since data processing is the primary candidate for review and updating due to both the relative currency of other computer-related programs compared to DPR and the long period of time since DPR was last extensively reviewed in the early 1970's. There is some overlap in the missions of the various computer programs at the college, especially between DPR and OIS, so that a review of the DPR program will generate information pertinent to OIS and the other computer-related programs at OCC.

At present, OCC offers an Associate degree program in DPR with four options. Appendix A contains excerpts from the 1989-90 OCC catalog of the coursework requirements for the four DPR options and descriptions of all of the DPR course offerings.

The oldest and most popular of the DPR options is business computer programming , which has not been reviewed since the early 70's. This program offers courses in Assembler and a variety of third-generation procedural languages with a concentration in COBOL. The implied context is programming for batch applications on a large stand-alone IBM mainframe environment. Program development is supported by line-mode terminals connected to an IBM3090 system running MVS/VM/CMS. Programs are created and maintained via the interactive CMS editor, with translation and testing supported by a batch que with fifteen minute turn-around. This option is the bulwark of the DPR program, producing over two-thirds of program graduates since this credential leads directly to entry-level employment.

The second degree option is the computer systems analysis option, which was installed in the late 1970's to offer a degree option to working programmers without degrees desiring a credential for career advancement. The option has not performed its intended function, since the systems analysis credential has evolved to the bachelor level. Instead, many students perceive it as the least rigorous path to the DPR associates degree and pursue this credential in spite of the fact that the degree alone without work experience does not lead to employment as a systems analyst.

The third degree option is the computer science technology option, installed concurrently with the system analysis option. The intent here was to offer a program with more technical and mathematical rigor than the business programming option for employment as a programmer in a more technical or engineering environment. This option is the least popular of the four due to computer science evolving into a bachelor -level credential coupled with the rigor of the coursework in this option.

Finally, the fourth and most recent option is the small computer system technology program, installed in 1985 in reaction to the explosive growth in the number of small computer systems in the marketplace. It is perhaps too early for a definitive judgement of the success of this option, but it has not been as popular as anticipated. Many of the courses are well received, but the number of graduates is low, leading to the possibility that the persons pursuing the coursework are not interested in the associates credential.

The enrollment patterns for the DPR program over the past few years are displayed on page 8 of appendix A. Enrollments peaked in 1984 and have been in slow decline since that time. This decline is not as severe as the national trend of enrollment decline in computer education programs (17). On the one hand, enrollment stabilization could be construed as the inevitable consequence of a national trend indicating program maturity. On the other hand, given the exponential growth of computing in an increasingly information-oriented society, flat enrollment is a cause for concern that current DPR programs both locally and nationally are increasingly irrelevant to current practices in applied computer technology.

Indicators of current computer specialist employment needs

Introduction: This section of the report will examine the 'fit' between the current DPR curriculum at OCC and the market for computer specialist employment in southeast Michigan. The indicators for assessment include gross projections of computer employment at the federal and regional levels, content analysis of both want -ads and computer specialist offerings by sister institutions, a review of the model curriculum offerings from the national computer service organizations and finally, surveys of both DPR ex-students and area employers.

Employment projections: In the publication Workplace-2000 (54), the federal government predicts a doubling of national computer specialist employment by the year 2000 through an annual growth rate of five percent. The MESC projects a fifty percent increase in computer employment in southeast Michigan from 1985-1995 (11, B). The MESC projections also include data suggesting that the entry-level output from schools should match entry-level needs and that shortages will occur in the areas of programming for both data base applications and communication networks. Finally, to offer a comparison to the high-growth sunbelt, the state of Florida projects a twenty two percent growth in computer specialist employment between 1989 and 1994 (17). The projections are all fairly similar, projecting an annual growth rate of between four and five percent.

This growth rate is four times the national average for growth in all occupations and six times the growth rate projected for all occupations in southeast Michigan (B:1). Computer specialist employment continues as on one of the fastest-growing occupations (B:2). Consequently, programs leading to computer specialist employment continue to be justified on the basis of overall market demand.

Want-ad content analysis: In September of 1987, Don Mann, an OCC computer science faculty member, analyzed the computer want-ads from one Sunday's editions of Detroit-area papers (48, C:19-22). The analysis revealed the most demand for CICS, COBOL, RPG, data base and fourth-generation language experience. He also solicited a letter from one of the leading computer placement services, which encouraged training in COBOL, fourth-generation languages and UNIX/C (C:23).

In December of 1988, 142 want-ads from the Detroit Free Press, the Detroit News and Computerworld magazine were examined by Larry Molloy, another member of the OCC computer science faculty (51, C:3-4). The most frequently mentioned topics were similar to the Mann analysis; the programming languages COBOL, RPG, 'C' and CICS, a variety of data base/application generator packages and a variety of personal productivity packages.

The current DPR program has extensive coursework in COBOL and personal productivity software, some coursework in 'C' and database, but does not offer coursework in either RPG or CICS.

Offerings of other institutions: Larry Molloy also analyzed the offerings of both sister and transfer institutions by course title and requirements (51, C:5-18). The author did a parallel analysis of the courses offered by sister institutions (20, C: 25). The conclusions from these analyses are:

1. OCC is congruent with sister institutions in the areas of introductory courses, COBOL, productivity package software and systems analysis concepts.
2. RPG is a language offered by most sister institutions but not OCC.
3. OCC lags behind the leading edge schools in the areas of telecommunications, data base/application generators, artificial intelligence and programming productivity tools.
4. There are major difficulties in transferring OCC courses as comparable classes to the four-year institutions in Michigan.
5. The CIS designation Computer Information Science/Systems has replaced DPR as the course prefix in the leading-edge schools.

Model Curricula: The existing DPR options fit well with both the model curriclum for community colleges from the ACM (45) and the first two years of the model undergraduate curriculum in computer information systems from the DPMA (15). However, there is some concern about the relevancy of these models to OCC at the current time. The ACM model was published in 1977 and is currently in the initial stages of revision. The DPMA model was published in 1981 and is directed to four-year programs; OCC 'fits' in the sense that the existing DPR option conforms to the old ACM model and that several existing DPR courses meet the requirements of the first two years of the DPMA model.

Survey of DPR ex-students: The author surveyed a sample of DPR ex-students in the Spring of 1988 (18, D:1-10). In summary, the ex-students.....

1. ...gave high marks to the quality of DPR coursework (D:4).
2. ...would recommend OCC to others for computer education (D:6).
3. ...are over 94% employed; 68% employed in a computer-related job; computer environment at work dissimilar to the computer environment at OCC (D:5).
4. ...ranked COBOL, IOCS, database application generation and telecommunications as the most important programming topics for job preparation (D:7).
5. ...ranked operating systems, systems analysis and problem solving as the most important conceptual topics for job preparation (D:8).
6. ...ranked written and verbal communication as the most important support topics for job preparation (D:10).

Although ranked high in overall quality, the DPR program appears deficient in the areas of telecommunications, data base and computer environment. The students were trained on a time-sharing mainframe to write batch-oriented programs, but were employed on systems using mid-range and personal computers with extensive data base and communications facilities.

Area employer survey: The author surveyed a sample of Oakland county employers (19, D:1-10), also in the Spring of 1988. In summary, the employers....

1. ...agree with students on the importance of written/ verbal communication support courses (D:10).
2. ...are using a preponderance of small or mixed-level computer system configurations (D:11) with operating environments predominantly IBM-MVS on large systems, MS-DOS on personal systems and a variety on mid-range systems (D:12).
3. ...are using computer communications in most cases (D:13-14).
4. ...acquire over half of their application software through contracting or package purchase (D:16).
5. ...use COBOL and 4th generation languages for program development (D:17).
6. ...have over two thirds of their employees using computer output directly tied to the computer as end-users (D:18) working with a wide range of personal productivity software (D-19).
7. ...project application programmers and OIS/PC specialists as the two largest categories for future computer employment needs (D:21- 22).

The DPR options meet employer demands for COBOL and productivity software, but again are deficient in the areas of computer communications and 4th generation languages. An additional concern related to communications is the lack of a linked, multi-level computer environment at OCC to match the wide variety of computer environments found in the service area.

Summary: Demand for computer specialists is projected to remain strong, but the job content is changing to refect the shift towards more complex, networked computer systems supporting end-user interaction as well as the traditional tasks of supporting batch applications and program development. The DPR program needs updating to reflect these changes, particularly in the areas of computer communications, 4th generation languages and a linked, multi-level computer system environment.

Literature forecasts of trends in computer technology

Computer trade journals, scholarly publications and recent books were scanned for references to evolving trends in computer technology over the next ten years. Particularly helpful in this regard was the Dialogue data base search system recently installed in the LRC's of OCC. The accumulated reference material was divided into five categories and is discussed in detail in appendix E. What follows is a summary of the major findings within each of those five categories:

1. The evolution of computer technology is inter-related with major individual and social changes as the industrial age is transformed into the information age.
2. First-generation personal computers are rapidly evolving into more powerful and capable tools called workstations.
3. Communication networks are evolving in tandem with workstations in order to tie work stations to each other, to shared resources and to other networks.
4. Networks are incompatible with closed, vendor-specific hardware platforms. Open system environments based on UNIX are evolving together with communication networks of workstations.
5. Software development is in crisis because of both the huge increase in demand for software and the major changes in software itself arising from the emergence of workstations, networks and open system philosophy. The strategies for meeting this crisis include empowering end-users with better software tools to ease the demand for new software and to improve the efficiency of software development through process control and automated code generation.

These trends coupled with the findings from the surveys of ex-DPR students and county employers point to the need for major revisions in the OCC computer curriculum to keep pace with evolving standards and practices.

Recommendations for a new computer information science curriculum

At a series of meetings over the past year, the computer science faculty have constructed a new curriculum in computer information science (CIS) in response to the findings from the need assessment process. The proposed CIS curriculum is displayed in appendix F. The major curricular recommendations are listed below, along with the need assessment concerns they address:

1. Replace DPR with CIS as the course designator to both better reflect the new curriculum content and bring OCC in line with the course desgnation used by leading-edge sister institutions.
2. Discontinue the computer science option pending the outcome of both the completion of the new model curriculum from the ACM and a closer analysis of the transfer requirements to bachelor programs.
3. Replace the options for systems analysis, business computer programming and small computer technology with a single associates degree program in computer application development and one year certificate programs in application packages and computer programming. With the increasing importance of networks of computers of different sizes and the trend towards application development on workstations, distinctive programs for mainframes and small computers are no longer necessary. The certificate options can serve as umbrellas for service courses for students interested in end-user packages and specific programming languages.
4. Two new one-credit courses in computer literacy (CIS100) and programming literacy (CIS101) as service courses to other disciplines and remedial courses for prospective computer students lacking basic skills and concepts.
5. A new course in Expert systems and AI (CIS130) to acquaint students with these increasingly important techniques identified in the literature.

6. A new course in special topics (CIS180) to allow the introduction of important emerging topics into the curriculum, such as object-oriented systems.
7. A new course in operating systems and architecture (CIS230) to meet the need for content in these areas expressed in the literature and by both ex-students and employers in the surveys.
8. A new course for intern practice (CIS240.4) to meet the need for applied experience for qualified students.
9. Minor course revisions to incorporate 'C' as the learning vehicle for programming (CIS112, CIS190 and CIS281). An in-depth experience with a single language which has practical utility is superior to learning several languages, some of which are not used in the workplace. 'C' is cited in both the want-ad analysis and the literature as being increasingly important.
10. Minor revisions to the COBOL series (CIS215 and CIS 245) to place a greater stress on application development tools and linkages to data bases and communication systems identified as important in the literature, want-ad analysis and surveys.
11. To make room for additions, a shift of the two Assembler courses (CIS 120, CIS220), Fortran (CIS115) and PL/I (CIS216) into the certificate program in computer programming.
12. Reactivate the RPG course (CIS123) as a service course in the programming certificate option in response to the want ad and survey findings.

Recommendations for computer system support of the CIS curriculum

To date , the computer science faculty have not completed their recommendations for the computer system environment to support the new CIS curriculum. The plan outlined below is the author's opinion of what is needed based on the literature review, surveys and demands of the new curriculum:

1. A campus network capable of supporting current MS-DOS/Windows and Macintosh PCs, workstations and X-window terminals.
2. The network should be UNIX-based and express the open systems philosophy by supporting a variety of desktop hardware platforms.
3. Servers on the network to support a gateway to the IBM mainframe, modems for dial-up, electronic mail, printers and network mass storage.
4. Network facility for distributed applications.
5. Network facility for CASE tools and object-oriented application construction.
6. Application development primarily via interactive workstations with network support for data base, tools, gateways and peripherals.

APPENDIX A

CURRENT DPR CURRICULA

Data Processing Degree Program —Orchard Ridge

Business Computer Programming Option

Data Processing offerings allow students to select one of four individual options to earn an Associate Degree in Applied Science.

This Associate Degree option is designed to give the student experience in computer application and data processing equipment in business and related fields. A graduate has opportunities for employment in many aspects of business or industry involving the use of electronic data processing facilities.

Major Requirements

			Credits
DPR	103	Principles of Computer Information Processing	4
DPR	112	Principles of Structured Programming	4
DPR	120	Computer Programming - Assembler I	4
DPR	203	Information Systems	3
DPR	215	Computer Programming—COBOL I	4
DPR	216	Computer Programming—PL/1	4
DPR	220[1]	Computer Programming - Assembler II	4
DPR	245	Computer Programming - COBOL II	4
DPR	253	Quantitative Computer Methods	3
DPR	263	Computer Programming Applications	3

Required Supportive Courses

ACC	111[2]	Proprietorship Accounting	3
BUS	101	Principles and Practices of Business	3
ENG	135★[3]	Business Communications	3
MAT	115★	Intermediate Algebra	4

General Education Requirements

See graduation requirements for an Associate in Applied Science Degree on Page 37.

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[1] DPR 115 may be substituted.
[2] ACC 251 may be substituted.
[3] ENG 151 may be substituted.
★ General Education courses listed as Required Supportive may be used to meet requirements of the General Education component.

Data Processing Degree Program

—Orchard Ridge

Computer Science Technology Option

Major Requirements			Credits
DPR	112	Principles of Structured Programming	4
DPR	115	Computer Programming—FORTRAN	4
DPR	120	Computer Programming - Assembler I	4
DPR	220	Computer Programming - Assembler II	4
DPR	253	Quantitative Computer Methods	3
DPR	280	High Level Computer Languages	4
DPR	281	Data Structures	4
DPR	282	Computer Architecture	4

Required Supportive Courses			
ENG	151★	English I	3
MAT	153★[1]	Statistics	3
MAT	163★[1]	College Algebra and Trigonometry	4
MAT	171★	Analytic Geometry and Calculus I	4
MAT	172★	Analytic Geometry and Calculus II	4

General Education Requirements

See graduation requirements for an Associate in Applied Science Degree on Page 37.

Data Processing offerings allow students to select one of four individual options to earn an Associate Degree in Applied Science.

This option leading to an Associate Degree in Applied Science is designed to prepare the student for a position as a Computer Programmer in the business or technical area of the data processing industry where emphasis is placed on developmental and/or scientific applications. The student will acquire the necessary mathematical, theoretical, and programming training in the areas of calculus and statistics, assembler languages, and high level languages, data organization, and internal computer architecture.

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[1] May be replaced by a more advanced mathematics course sequence.

★General Education courses listed as Required Supportive may be used to meet requirements of the General Education component.

A-2

Data Processing Degree Program
—Orchard Ridge
Computer Systems Analysis Option

Data Processing offerings allow students to select one of four individual options to earn an Associate Degree in Applied Science.
This option leading to an Associate Degree in Applied Science is designed to prepare the data processing student with previous computer-related work experience for an entry position as a Systems Analyst in businesses with financial and information management data processing systems.

Major Requirements			**Cre**
DPR	103	Principles of Computer Information Processing	
DPR	112	Principles of Structured Programming	
DPR	115	Computer Programming - Fortran	
DPR	203	Information Systems	
DPR	215	Computer Programming—COBOL I	
DPR	253	Quantitative Computer Methods	
DPR	280	High Level Computer Languages	
DPR	281	Data Structures	
DPR	283	Advanced Information Systems	

Required Supportive Courses		
ACC	251	Principles of Accounting I
BUS	101	Principles and Practices of Business
ENG	135★	Communications For Careers
ENG	221★	Business Writing
MAT	115★	Intermediate Algebra

General Education Requirements

See graduation requirements for an Associate in Applied Science Degree on Page 37.

★ General Education courses listed as Required Supportive may be used to meet requirements of the General Education component.

A-3

Data Processing Degree Program
—Orchard Ridge
Small Computer System Technology Option

Major Requirements			Credits
DPR	103	Principles of Computer Information Processing	4
DPR	112	Principles of Structured Programming	4
DPR	125	Structured Programming in BASIC	4
DPR	203	Information Systems	3
DPR	205	Small Computer Application Software	4
DPR	285	Small Computer System Architecture	4
DPR	106	Microcomputer Spreadsheet Concepts	3
DPR	108	Microcomputer Database Concepts	3
DPR	190	UNIX Operating System/C Language	4
DPR	263	Computer Programming Applications	3

Required Supportive Courses			
ACC	111	Proprietorship Accounting	3
	or		
ACC	251	Principles of Accounting I	4
BUS	101	Principles and Practices of Business	3
	or		
BUS	121	Starting and Operating a Small Business	3
ENG	135★	Business Communications	3
	or		
ENG	151★	English I	3
MAT	115★	Intermediate Algebra	4
	or		
MAT	150★	Finite Mathematics	4

General Education Requirements

See graduation requirements for an Associate in Applied Science Degree on Page 37.

Necessary Electives to Total .... **62 Credits**

Data Processing offerings allow students to select one of four individual options to earn an Associate Degree in Applied Science.

This Associate Degree option is designed to give the student experience in the design and development of information systems on small computers. Many opportunities exist for small computer specialists in business and industry.

★ General Education courses listed as Required Supportive may be used to meet requirements of the General Education component.

(DPR)

Data Processing

DPR 103 **4 Credits**
Principles of Computer Information Processing
Corequisite: DPR 112 suggested for DPR majors
This course introduces the student to information processing concepts and explores the impact of computer technology on our society. The student will investigate word processing, spreadsheet and data base applications. The student will be introduced to the various components of computer systems, applications software, computer hardware concepts and a survey of computer programming languages. The student will complete several programming and application package exercises. No previous computer experience is assumed. Course fee.

DPR 106 **3 Credits**
Microcomputer Spreadsheet Concepts
Prerequisites: OIS 210.3 or DPR 103 or consent of instructor.
The student will utilize a microcomputer spreadsheet package to solve problems and develop sotlutions that lend themselves to the spreadsheet environment. The course will examine in detail: spreadsheet command menus, macro writing, importing data files, template creation, graphics facilities, and interactive use of spreadsheets. Consult schedule of classes for information on the software package being for the course. Course fee.

DPR 108 **3 Credits**
Microcomputer Database Concepts
Prerequisites: OIS 210.5 or DPR or consent of instructor.
The student will utilize a microcomputer database package implement database solutions common application areas involve microcomputers. The course will cover in detail: database commands, relational database concepts, menus, screen design report writing features, and database programming. consult schedule of classes for information on the software package being for the course. Course fee.

DPR 112 **4 Credits**
Principles of Structured Programming
Corequisite: DPR 103 suggested DPR majors
The student will be introduced to concepts of top down problem analysis and structured program design and development. Structured selection, iteration, procedure control and input/output constructs are presented. Methods of planninng and documenting program structure (examples: pseudocode, Nassi-Schniderman charts) are discussed. Test data design and program debugging strategies are presented. The student will complete several programming assignments outside of class. No previous computer experience is assumed. Course fee

DPR 115 **4 Credits**
Computer Programming - Fort
Prerequisite: Secondary school algebra or MAT 110.
The student will be introduced to basic computer principles and a complete study of the FORTRAN programming language. Applications in business, science and engineering related disciplines will be discussed. The student will complete several programming

assignments outside of class. No previous computer experience is assumed. Course fee.

DPR 120 4 Credits
Computer Programming - Assembler I
Prerequisite: DPR 112
The student will be introduced to the instruction set and Assembler language of a third generation computer (example: IBM 360/370). The student will learn the function of mnemonics. Labels and translator programs; how to define data and constants; I/O and processing instructions; and selection and structuring of Assembler assignments outside of class. Course fee.

DPR 125 4 Credits
Structured Programming in Basic
Prerequisite: DPR 103 or DPR 112
The student will be introduced to concepts of solving problems via the BASIC computer programming language. Discussion of advanced language extensions such as files and graphics are included. The student will complete several programming assignments outside of class. Course fee.

DPR 190 4 Credits
Unix Operating System/C Language
Prerequisites: DPR 112 or equivalent programming experience, or consent of department.
This course is designed to provide an introduction on the UNIX Operating System facilities and commands. An introduction to the C Programming Language will be presented with emphasis on fundamental language structure, data types, and syntax.
Programming or operating system assignments will be required to be completed outside of class. Course fee.

DPR 203 3 Credits
Information Systems
Prerequisite: DPR 112
The student will survey and practice the techniques used by systems analysts in the analysis, design and implementation of information systems. System specifications, equipment selection, system flow-charting, interviewing, file design and processing and conversion techniques are among the topics that are included.

DPR 205 4 Credits
Small Computer Application Software
Prerequisites: DPR 103 and DPR 125
The student will be instructed in the selection and use of common software packages available for small computers. Such packages as business graphics, data base, word processors, spreadsheets and integrated systems will be emphasized. Students will complete several assignments outside of class. Course fee.

DPR 215 4 Credits
Computer Programming - COBOL I
Prerequisite: DPR 112
The student will be instructed in the structure, form and syntax of the ANSI COBOL programming language. Emphasis will be placed on structured, top down programming techniques and use of pseudocode. Concepts include file processing, loop control, tables and sub-routines. Programming assignments will be completed outside of class. Course fee.

DPR 216 4 Credits
Computer Programming - PL/I
Prerequisites: DPR 120 and DPR 215
The student will be instructed in the structure, form and syntax of the PL/I language. Emphasis will be placed on top down structured programming techniques. Concepts explored and utilized in the course include recursive subroutines, functions, multi-tasking, string handling, bit and Boolean operations, dynamic and static memory allocation, file organizations and programming efficiency. Students will complete several programming assignments outside of class. Course fee.

DPR 220 4 Credits
Computer Programming -Assembler II
Prerequisite: DPR 120
The student will be instructed in advanced techniques in Assembler language programming. Extensive coverage will be given to the IBM 360/370 instruction set not covered in DPR120. Concepts covered include control section, dummy sections, dynamic memory allocation, large scale program development, macros, physical IOCS, arrays and efficient coding considerations. The student also will explore operating system concepts and inter-relationships (supervision functions, interrupts, priveleged instructions, linkage editor, system libraries, job control languages and utilities). The student will complete several advanced programming assignments outside of class. Course fee.

DPR 245 4 Credits
Computer Programming - COBOL II
Prerequisite: DPR 215
The student will be instructed in advanced programming techniques utilizing the ANSI COBOL language. Concepts include advanced searching and table lookup, index and random access file techniques and large scale program development projects. Several advanced programming assignments will be completed outside of class. Course fee.

DPR 253 3 Credits
Quantative Computer Methods
Prerequisites: Secondary school algebra and one of DPR 112, DPR 115, DPR 216.
The student will be instructed in the mathematical methods currently being used on computers to analyze business data. Simulation methods, linear programming and critical path network analysis are topics that are included. The student will complete several computer exercises outside of class. Course fee.

DPR 263 3 Credits
Computer Programming Applications
Prerequisites: DPR 216 and DPR 245 or consent of instructor.
The student will be instructed in various professional aspects of the computer programming profession such as recent technological advances, career planning, and professional associations. The student also will study advanced concepts of good programming style and computer programming applications. The student will complete several advanced programming assignments outside of class. Course fee.

DPR 280 **4 Credits**
High Level Computer Languages
Prerequisites: DPR 112 and DPR 115 or DPR 215 or DPR 216
The student will investigate one or more 4th or 5th generation programming languages. Emphasis for the high level language will relate to concepts involving one or more of the following: array processing, artificial intelligence, list and/or symbol recognition. The student will complete several assignments outside of class. Course fee.

DPR 281 **4 Credits**
Data Structures
Prerequisites: DPR 112 and DPR 115 or DPR 216
The student will investigate the programming techniques and theory involved to implement lists, queries, string storage, storage allocation, sorting and tree structures. The student will complete several assignments outside of class. Course fee.

DPR 282 **4 Credits**
Computer Architecture
Prerequisites: DPR 220, MAT 163
The student will analyze and investigate digital computer systems, hardware concepts and components, circuit minimization, information transfer, implications of hardware design, and software interaction.

DPR 283 **4 Credits**
Advanced Information Systems
Prerequisites: DPR 203 and DPR 281
This course will cover the more sophisticated use and development of Information Systems. Topics will include a survey of Data Base packages and Data Base techniques. Data Base design, implementation and recovery techniques will be explored. The student will complete several assignments outside of class. Course fee.

DPR 285 **4 Credits**
Small Computer Systems Architecture
Prerequisites: DPR 125 and DPR 205
The student will explore the hardware and software architecture of several small computer systems. Student will be introduced to low level language programming concepts appropriate for small computers. Student will be exposed to a variety of micro computer instruction sets and comparative features will be discussed. An overview of operating systems and system networking will be presented. The student will complete several assignments outside of class. Course fee.

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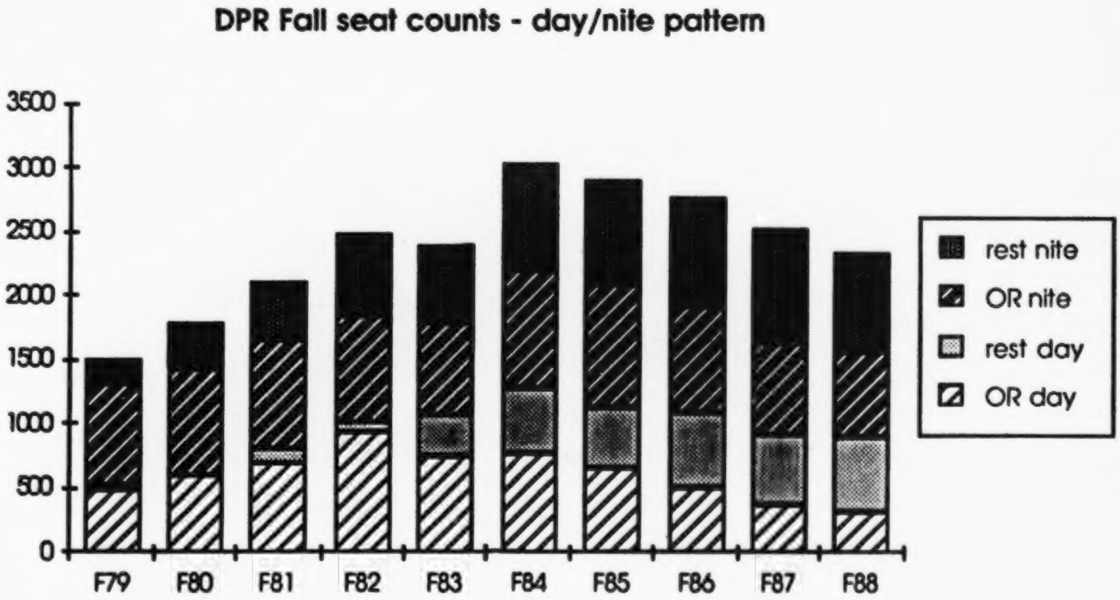
A-8


DPR Fall seat counts - day/nite pattern
3500
3000
2500
2000
1500
1000
500
0
F79
F80
F81
F82
F83
F84
F85
F86
F87
F88
rest nite
OR nite
rest day
OR day

OCCUPATIONAL ANALYSIS Detroit Metro Area
CLUSTER: COMPUTER AND INFORMATION SCIENCES

APPENDIX B 6/27/89
MESC PROJECTION

The demand for computer programmers and systems analysts is projected to remain strong in Michigan. Long term employment is expected to rise much faster than the average for all occupations. The rapid employment gains in these fields led to a substantial increase in post secondary training. Current post secondary training levels appear to provide an adequate supply of workers, but shortages may still occur in specialized areas. Job prospects should be best for college graduates trained in a variety of computer languages, particularly newer languages that apply to data base management and computer networking. It is also important to note that computer literacy is increasingly needed in a broad range of work settings and occupations.

OCCUPATIONAL SUPPLY SUMMARY: Detroit Metro Area
CLUSTER: COMPUTER AND INFORMATION SCIENCES
SUPPLY

Total	2045
Secondary Vocational Education	0
Post Secondary Education	694
Private Vocational Education	803
Apprenticeship Training	0
Four Year College & Professional	548

OCCUPATIONAL DEMAND SUMMARY: Detroit Metro Area

	EMPLOYMENT		AVERAGE ANNUAL OPENINGS	
	1985	1995	TOTAL	REPLCMT
Cluster	20150	29900	1115	140
Computer programmers	12150	18800	735	70
Computer systems analysts, EDP	8000	11100	380	70

OCCUPATIONAL SUPPLY/DEMAND INDICATORS: Detroit Metro Area
CLUSTER: COMPUTER AND INFORMATION SCIENCES

Occupational Employment Growth Rates	Comparison Cluster ->	Total
United States (1985-2000):	72.2	19.2
Area (1985-1995):	48.4	8.2
Michigan Statewide (1985-1995):	45.3	9.5

Supply/Demand & Student Follow-up	Comparison Cluster ->	Total
Area Supply/Projected Demand Ratio:	1.8	1.0
Statewide Secy. VocEd Unemp Ratio:	*	*
Statewide Post Secy. & 4 Yr Unemp Ratio:	13.9	11.6

* Data Not Available Or Not Applicable.

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Detroit Metro Area OCCUPATIONS BY GROWTH RATE

6/27/89 ~~Page 1 of~~

Search Condition: SVP > 4 & SVP < 8& OPENS > 40 & RATE > 11

Output Sort Order: RATE Descending

Cutoff=8

OCCUPATION	OS&D CODE	EMPL 1985	FORECAST 1995	GROWTH	%CHG	ANNUAL OPENING
==========	====	====	====	======	====	=======
Aircraft pilots & fl. engineer	0	1150	1800	650	56.5	95
Computer programmers	21	12150	18800	6650	54.7	735
Aircraft mech. & engine special.	70	700	1050	350	50.0	45
Securities & fin. serv. sales	0	3900	5800	1900	48.7	430
Social welfare service aides	0	2800	4000	1200	42.9	250
Emp. interviewers, emp. serv.	0	850	1200	350	41.2	65
Paralegal personnel	14	750	1050	300	40.0	50
Law clerks	0	1000	1400	400	40.0	100
Computer systems analysts, EDP	21	8000	11100	3100	38.7	380
Registered nurses	48	27750	37550	9800	35.3	1670
Electri. & electro. technicians	23	5400	7300	1900	35.2	270
Medical assistants	40	3850	5150	1300	33.8	220
Teachers, preschool & kindergarte	0	4150	5450	1300	31.3	250
Computer op., ex. periph. eqpt.	11	4900	6300	1400	28.6	190
New accounts clerks	0	900	1150	250	27.8	55
Social workers	06	5800	7400	1600	27.6	300
Real estate appraisers	6	550	700	150	27.3	55
Optometrists	98	550	700	150	27.3	65
Artists & commercial artists	20	4600	5850	1250	27.2	245
Elec. home enter. eq. repair	23	800	1000	200	25.0	50
Loan & credit clerks	0	1200	1500	300	25.0	60
Opticians, dispensing & measuring	45	1250	1550	300	24.0	70
Housekeepers, institutional	0	2100	2600	500	23.8	160
AO health prof. & paraprofess.	0	4800	5900	1100	22.9	190
Dental hygienists	31	2000	2450	450	22.5	55
Carpenters	56	9900	12100	2200	22.2	550
Dental assistants	30	3200	3900	700	21.9	100
P.R. specialists & pub. writer	0	1150	1400	250	21.7	65
Off. mach. & cash reg. servicer	23	700	850	150	21.4	45
Teachers & instruc., voc. educ	0	3300	4000	700	21.2	220
AO management support worker	0	14200	17200	3000	21.1	880
Brokers, real estate	6	950	1150	200	21.1	80
Instructors, adult nonvoc. educ.	0	2400	2900	500	20.8	160
Concrete & terrazzo finishers	0	1700	2050	350	20.6	85
Cabinetmakers & ben. carpenter	76	750	900	150	20.0	55
Roofers	59	2500	3000	500	20.0	90
Operating engineers	61	2600	3100	500	19.2	120
Heat., A/C & refrig. mech. & rep.	62	3400	4050	650	19.1	155
Counselors	0	1350	1600	250	18.5	55
Dietetic technicians	0	1100	1300	200	18.2	60
Photographers	17	1650	1950	300	18.2	100
Designers, ex. interior design	0	6350	7500	1150	18.1	335
Sales agents, real estate	6	8850	10400	1550	17.5	725
Cooks, restaurant	53	9300	10900	1600	17.2	460
Cooks, instit. or cafeteria	53	4400	5150	750	17.0	215

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6/27/89

Computer programmers - DISTRIBUTION BY INDUSTRY (MICHIGAN) Page 1 of 1
Search Condition: Output Sort Order: EMP85 Descending
Cutoff = 50

Industry Title	SIC CODE	1985 Employment	Percent Distribution
Computer and Data Processing Servi	737	7397	41.74
Motor Vehicles and Equipment	371	1668	9.41
Colleges & Universities	822	981	5.54
Miscellaneous Business Services	739	953	5.38
Commercial and Stock Savings Banks	602	321	1.81
Hospitals	806	300	1.69
Local Government,Exc.Educ & Health	930	260	1.47
Machinery, Equipment, and Supplies	508	230	1.30
Gas Companies and Systems	492	217	1.22
Fire, Marine, and Casualty Insuran	633	205	1.16
Drugs	283	204	1.15
Federal Government	910	194	1.09
State Government,Exc.Educ & Health	920	191	1.08
Personal Credit Institutions	614	182	1.03
Engineering,Architect.,Surveying S	891	181	1.02
Elementary & Secondary Schools	821	168	0.95
Groceries and Related Products	514	168	0.95
Life Insurance	631	166	0.94
Metalworking Machinery	354	137	0.77
Miscellaneous Plastics Products	307	134	0.76
Accounting,Auditing, & Bookkeeping	893	131	0.74
Savings and Loan Associations	612	119	0.67
Motor Vehicles and Auto Parts and	501	100	0.56
Construction and Related Machinery	353	97	0.55
Mailing,Repro.,Comm.Art,& Steno. S	733	96	0.54
Trucking, Local and Long Distance	421	89	0.50
Office, Computing Machinery	357	78	0.44
Noncommercial Educ.,Scient.,Resear	892	75	0.42
Office Furniture	252	70	0.40
General Industrial Machinery	356	65	0.37
Miscellaneous Machinery, Except El	359	64	0.36
Telephone Communication	481	61	0.34
Industrial Organic Chemicals	286	58	0.33
Electrical Goods	506	56	0.32
Fabricated Structural Metal Produc	344	55	0.31
Religious Organizations	866	54	0.30
Metal Stampings	346	53	0.30
Insurance Agents,Brokers,& Service	641	50	0.28
Refrigeration and Service Machiner	358	46	0.26
Offices Of Physicians	801	44	0.25
Commercial Printing	275	43	0.24
Preserved Fruits and Vegetables	203	41	0.23
Engines and Turbines	351	40	0.23
Legal Services, Total	811	39	0.22
Department Stores	531	38	0.21
Hardware, Plumbing, and Heating Su	507	38	0.21
Blast Furnaces and Basic Steel Pro	331	38	0.21
Cutlery, Hand Tools, and Hardware	342	37	0.21
Personnel Supply Services	736	35	0.20

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APPENDIX C

L. MOLLOY

Attachment #1.A

WANT AD SURVEY - RESULTS BY TOPIC

Listed by total number of ads requesting the topic

Total Ads Examined: 142

	Data for all ads		Ads placed by a particular company		Ads placed by a placement org.	
TOPIC	# ads found	% of all ads found	COUNT	%	COUNT	%
COBOL	69	48.6%	44	64%	25	36%
RPG-TOTAL	41	28.9%	25	61%	16	39%
RPG III	36	25.4%	22	61%	14	39%
C	25	17.6%	15	60%	10	40%
CICS	19	13.4%	7	37%	12	63%
Micro Apps.	17	12.0%	14	82%	3	18%
PL/I	16	11.3%	5	31%	11	69%
MS-DOS	15	10.6%	12	80%	3	20%
ASSEMBLER	14	9.9%	14	100%	0	0%
VAX	14	9.9%	10	71%	4	29%
UNIX	13	9.2%	7	54%	6	46%
DB2	12	8.5%	3	25%	9	75%
DC/DB	12	8.5%	3	25%	9	75%
Data Base	11	7.7%	7	64%	4	36%
FORTRAN	11	7.7%	8	73%	3	27%
IMS	9	6.3%	2	22%	7	78%
JCL	9	6.3%	7	78%	2	22%
BASIC	8	5.6%	7	88%	1	13%
FOCUS	8	5.6%	2	25%	6	75%
ORACLE	8	5.6%	2	25%	6	75%
dBASE	5	3.5%	4	80%	1	20%
Networking	5	3.5%	3	60%	2	40%
RPG II	5	3.5%	3	60%	2	40%
SQL	5	3.5%	0	0%	5	100%
CMS	4	2.8%	2	50%	2	50%
MVS	4	2.8%	3	75%	1	25%
Macintosh	3	2.1%	1	33%	2	67%
NOVELL	3	2.1%	1	33%	2	67%
PASCAL	3	2.1%	3	100%	0	0%
ADA	1	0.7%	0	0%	1	100%

C QUESTIONS	Count	Percent of that ad type
Total C ads found	25	
Ads listing both Assembler and C	7	28%
Ads listing both UNIX and C	9	36%
Ads listing both C and BASIC	3	12%
Ads listing both C and COBOL	4	16%
Ads listing both C and DB/DC	4	16%

Ads that also include C:	Count	Percent of that ad type
Assembler ads listing C	7	50%
UNIX ads listing C	9	69%
BASIC ads listing C	3	38%
COBOL ads listing C	4	6%
DB/DC ads and C	4	33%

Attachment #1.B

WANT AD SURVEY - RESULTS BY TOPIC
General data and listing by type of source

Total Ads Examined:	142

SURVEY RESULTS

Jobs by Source:	
Detroit News	105
Computerworld	28
Detroit Free Press	9

Jobs by Position	
Programmer	80
Programmer Analyst	50

Jobs by Type of Opening	
Company Placed Ad	93
Placement Service	49

Topics listed by all sources
- COBOL
- RPG-TOTAL
- RPG III
- C
- CICS
- Micro Apps.
- PL/I
- MS-DOS
- ASSEMBLER
- VAX
- UNIX
- DB2
- DC/DB
- Data Base
- FORTRAN
- IMS
- JCL
- BASIC
- FOCUS
- ORACLE
- dBASE
- dBASE
- SQL
- RPG II
- MVS
- CMS
- Macintosh
- NOVELL
- PASCAL
- ADA

Topics listed by particular companies only
- COBOL
- RPG-TOTAL
- RPG III
- C
- ASSEMBLER
- Micro Apps.
- MS-DOS
- VAX
- FORTRAN
- BASIC
- CICS
- Data Base
- JCL
- UNIX
- PL/I
- dBASE
- DB2
- DC/DB
- MVS
- Networking
- PASCAL
- RPG II
- CMS
- FOCUS
- IMS
- ORACLE
- Macintosh
- NOVELL
- ADA
- SQL

Topics listed by placement orgs.
- COBOL
- RPG-TOTAL
- RPG III
- CICS
- PL/I
- C
- DB2
- DC/DB
- IMS
- FOCUS
- ORACLE
- UNIX
- SQL
- Data Base
- VAX
- FORTRAN
- Micro Apps.
- MS-DOS
- CMS
- JCL
- Macintosh
- Networking
- NOVELL
- RPG II
- ADA
- BASIC
- dBASE
- MVS
- ASSEMBLER
- PASCAL

C-2

Attachemt #2.A

List of Computer Classes - Alphabetical sequence

		Course title offered by :					
Course Title	Level	# 2 yr schools	%	# 4 yr schools	%	Total schools	%
Accounting Systems	200	1	8%	0	0%	1	3%
Advanced BASIC	300	2	15%	1	5%	3	9%
Advanced C' programming Language	200	1	8%	0	0%	1	3%
Advanced COBOL Programming	200	1	8%	2	10%	3	9%
Advanced Computer Organization	400	0	0%	1	5%	1	3%
Advanced Comp. Prog. - COBOL II	200	1	8%	0	0%	1	3%
Advanced Concepts in Computer Science	500	0	0%	1	5%	1	3%
Advanced Concepts in Parsing	500	0	0%	1	5%	1	3%
Advanced Concepts in Software Development	500	0	0%	1	5%	1	3%
Advanced Database Concepts	400	0	0%	1	5%	1	3%
Advanced Database with 4th Generation Languages	400	1	8%	0	0%	1	3%
Advanced FORTRAN	200	0	0%	1	5%	1	3%
Advanced Information Systems	200	1	8%	0	0%	1	3%
Advanced Microcomputer Concepts for Teachers	500	0	0%	1	5%	1	3%
Advanced Office Systems	400	1	8%	1	5%	2	6%
Advanced Office & Telecommunications Systems	400	0	0%	1	5%	1	3%
Advanced PASCAL for Business and Industry	200	1	8%	0	0%	1	3%
Advanced Programming Concepts(logic, C')	200	1	8%	0	0%	1	3%
Advanced Programming Concepts(OCL, RPG II)	200	1	8%	0	0%	1	3%
Advanced Programming for Microcomputers (BASIC)	200	1	8%	0	0%	1	3%
Advanced Programming Language Concepts	500	0	0%	1	5%	1	3%
Advanced Prog. Applications(PASCAL)- Math Dept.	200	1	8%	0	0%	1	3%
Advanced RPG Programming	300	1	8%	0	0%	1	3%
Advanced Software Appl. for the Micro(WP,DB,SS)	200	1	8%	0	0%	1	3%
Advanced Software Design(C', LISP, ADA, SNOBOL)	400	1	8%	0	0%	1	3%
Advanced Structured COBOL	200	0	0%	1	5%	1	3%
Advanced Structured COBOL Programming	400	0	0%	1	5%	1	3%
Advanced Systems Design and Implementation	400	0	0%	1	5%	1	3%
Advanced Systems Design & Management	400	0	0%	1	5%	1	3%
Advanced Systems Programming&Design(uses COBOL)	400	0	0%	1	5%	1	3%
Advanced Topics in Computer and Info. Science	500	0	0%	1	5%	1	3%
Advanced Topics in Data Management	400	0	0%	1	5%	1	3%
Alternative Programming Languages(APL,LISP,ADA)	200	0	0%	1	5%	1	3%
An Intro to Computers with Applications	100	0	0%	1	5%	1	3%
Analysis of Algorithms	600	0	0%	1	5%	1	3%
Analysis of Computer Systems	500	0	0%	1	5%	1	3%
Analysis of File Systems and Structures	300	0	0%	1	5%	1	3%
APL Programming	100	0	0%	1	5%	1	3%
Application Systems	200	0	0%	1	5%	1	3%
Applications in Cmp Sci(LOGO,PASCAL,BASIC,DB,SS)	300	0	0%	1	5%	1	3%
Applications Software III/Wordstar	100	1	8%	0	0%	1	3%
Applications Software II/Lotus 123	100	1	8%	0	0%	1	3%
Applications Software I/Framework	100	1	8%	0	0%	1	3%
Applications/Documentation, Design and Writing	200	0	0%	1	5%	1	3%
Applied CIS Developemnt Project	400	0	0%	1	5%	1	3%
Applied Data Structures	300	0	0%	1	5%	1	3%
Applied Linear Statistical Models	400	0	0%	1	5%	1	3%
Applied Software Development	400	0	0%	1	5%	1	3%
Artificial Intelligence	300	0	0%	1	5%	1	3%

		2 year		4 year		total	
Artificial Intelligence I	600	0	0%	2	10%	2	6%
Artificial Intelligence Programming with LISP	500	0	0%	1	5%	1	3%
Assembler I (Comp Prog -)	100	3	23%	0	0%	3	9%
Assembler II (Comp Prog -)	200	2	15%	0	0%	2	6%
Assembler Language Programming	200	0	0%	4	19%	4	12%
Assembly and Machine Language Programming	200	0	0%	1	5%	1	3%
Assembly Language I	200	0	0%	1	5%	1	3%
Assembly Language II	300	0	0%	1	5%	1	3%
Assembly Language Programming	400	0	0%	1	5%	1	3%
Assembly Language Programming and Comp. Systems	300	0	0%	1	5%	1	3%
Assembly Language Programming - Math Dept	200	1	8%	0	0%	1	3%
Audit & Control of Accounting & Info. Systems	400	0	0%	1	5%	1	3%
Automated Communications	300	0	0%	1	5%	1	3%
Basic Assembly Language	400	0	0%	1	5%	1	3%
BASIC for Business and Industry	100	1	8%	0	0%	1	3%
BASIC for Engineers	100	0	0%	1	5%	1	3%
BASIC for Technology (Not for DPR majors)	200	1	8%	0	0%	1	3%
BASIC I (BASIC Programming I, Comp Prog -)	100	4	31%	0	0%	4	12%
BASIC II (BASIC Prog II,Int. BASIC)	200	3	23%	0	0%	3	9%
BASIC Programming	100	2	15%	1	5%	3	9%
BASIC Programming for Microcomputers	100	1	8%	0	0%	1	3%
BASIC Prog. - Math Dept.	100	2	15%	1	5%	3	9%
Basic Systems Analysis	200	1	8%	0	0%	1	3%
Business Applications of BASIC Language	200	0	0%	1	5%	1	3%
Business Applications of COBOL Language I	200	0	0%	1	5%	1	3%
Business Applications of COBOL Language II	200	0	0%	1	5%	1	3%
Business Applications Programming	200	1	8%	0	0%	1	3%
Business Computer Systems and Management	300	1	8%	0	0%	1	3%
Business Com. Software (W.P., data com E. Mail)	100	1	8%	0	0%	1	3%
Business Data Communiactions	400	0	0%	1	5%	1	3%
Business Data Management Software(DB, SS)	200	1	8%	0	0%	1	3%
Business FORTRAN	200	1	8%	0	0%	1	3%
Business Programming - BASIC	200	3	23%	0	0%	3	9%
Business Programming - RPG III	200	1	8%	0	0%	1	3%
Business Quantitative Methods Applications	300	0	0%	1	5%	1	3%
Business Statistics Applications	300	0	0%	1	5%	1	3%
Business Systems Analysis and Design	200	1	8%	0	0%	1	3%
Business Systems Applications	400	0	0%	1	5%	1	3%
C Programming Language	200	1	8%	0	0%	1	3%
CAD/CAM Applications	300	0	0%	1	5%	1	3%
Career Practices Seminar	200	1	8%	0	0%	1	3%
CICS Programming	200	1	8%	0	0%	1	3%
CIS Case Studies	400	1	8%	0	0%	1	3%
COBOL and File Management	200	0	0%	1	5%	1	3%
COBOL Applications	400	0	0%	1	5%	1	3%
COBOL I (COBOL Programming I, Comp Prog -)	200	11	85%	7	33%	18	53%
COBOL II (COBOL Prog. II,Comp Prog -)	200	8	62%	2	10%	10	29%
COBOL III (COBOL prog III)	300	2	15%	0	0%	2	6%
Comparative Prog. Langs(APL,LISP,LOGO,4th,Pilot)	400	0	0%	1	5%	1	3%
Compartv Langs.(BASIC,PL/I,PASCAL,FORTRAN,ALGOL)	200	1	8%	0	0%	1	3%
Compiler Construction(or Complr. Design)	500	0	0%	4	19%	4	12%
Compiler Design and Implementation	500	0	0%	1	5%	1	3%
Computation Theory	500	0	0%	1	5%	1	3%
Computational Algorithms: Analysis	600	0	0%	1	5%	1	3%
Computational Modeling Laboratory	500	0	0%	1	5%	1	3%
Computational Modeling of Comples Systems	500	0	0%	1	5%	1	3%

C-4

Computational Models and Problem Solving	200	0	0%	1	5%	1	3%
Computer and Info Processing (general)	100	1	8%	0	0%	1	3%
Computer Applications in Classroom Instruction	500	0	0%	1	5%	1	3%
Computer Applications in Educational Admin.	500	0	0%	1	5%	1	3%
Computer Architecture	300	2	15%	0	0%	2	6%
Computer Concepts for Public Administrators	500	0	0%	1	5%	1	3%
Computer Concepts(WP, SS, Apps and literacy)	100	1	8%	0	0%	1	3%
Computer Functions(DB, Langs, Lit)	100	1	8%	0	0%	1	3%
Computer Fundamentals	100	0	0%	1	5%	1	3%
Computer Generated Business Graphs	100	1	8%	0	0%	1	3%
Computer Graph Structures	600	0	0%	1	5%	1	3%
Computer Graphics	200	0	0%	2	10%	2	6%
Computer Graphics	500	1	8%	4	19%	5	15%
Computer Information Systems	100	0	0%	1	5%	1	3%
Computer Literacy	100	2	15%	0	0%	2	6%
Computer Marketing I	200	0	0%	1	5%	1	3%
Computer Marketing II	300	0	0%	1	5%	1	3%
Computer Networking Principles	400	0	0%	1	5%	1	3%
Computer Networks and Distributed Systems	500	0	0%	1	5%	1	3%
Computer Networks I	500	0	0%	1	5%	1	3%
Computer Operating Systems	500	0	0%	3	14%	3	9%
Computer Operating Systems and Applications	100	0	0%	1	5%	1	3%
Computer Operating Systems (Survey)	100	1	8%	0	0%	1	3%
Computer Operations Internship	100	1	8%	0	0%	1	3%
Computer Operations(operator tasks)	200	4	31%	0	0%	4	12%
Computer Organization	300	0	0%	4	19%	4	12%
Computer Organization and assembly Language	200	0	0%	1	5%	1	3%
Computer Organization and Systems	300	0	0%	1	5%	1	3%
Computer Prog Applications(Field work,careers)	200	1	8%	0	0%	1	3%
Computer Program Design	100	1	8%	0	0%	1	3%
Computer Programming and Numeric Methods	200	0	0%	1	5%	1	3%
Computer Programming I (uses PASCAL)	100	0	0%	2	10%	2	6%
Computer Programming II (uses PASCAL)	100	0	0%	2	10%	2	6%
Computer Programming in COBOL I	300	0	0%	1	5%	1	3%
Computer Programming in COBOL II	300	0	0%	1	5%	1	3%
Computer Programming Internship	200	1	8%	0	0%	1	3%
Computer Programming (uses BASIC)	100	0	0%	1	5%	1	3%
Computer Science Content for Elementary Teachers	500	0	0%	1	5%	1	3%
Computer Science I (uses PASCAL)	100	0	0%	2	10%	2	6%
Computer Science II (uses PASCAL)	200	0	0%	2	10%	2	6%
Computer Science Overview	100	0	0%	1	5%	1	3%
Computer Science Seminar	500	0	0%	1	5%	1	3%
Computer Software Tools(SS, DB, WP)	100	1	8%	0	0%	1	3%
Computer Systems Design	200	1	8%	0	0%	1	3%
Computer Systems Sales and Marketing	400	1	8%	0	0%	1	3%
Computer Theory	100	1	8%	0	0%	1	3%
Computer Usage for the Behaviorial Scientist	500	0	0%	1	5%	1	3%
Computer Usage(Business)	100	1	8%	0	0%	1	3%
Computerized Accounting Systems	200	1	8%	0	0%	1	3%
Computers and Mankind	200	0	0%	1	5%	1	3%
Computers and Society	100	0	0%	3	14%	3	9%
Computers and the Schools	400	0	0%	1	5%	1	3%
Computers for the Non-Specialist	100	0	0%	1	5%	1	3%
Computers in Business	100	2	15%	0	0%	2	6%
Computers in Business I	200	0	0%	1	5%	1	3%
Computers in Business II	300	0	0%	0	0%	0	0%

Computing and Data Processing Math	100	0	0%	0	0%	0	0%
Computing for Elementary School Teachers	200	0	0%	1	5%	1	3%
Cooperative Education	400	0	0%	1	5%	1	3%
Cooperative Education in Computer Science	300	0	0%	1	5%	1	3%
Cooperative Education Project	400	0	0%	1	5%	1	3%
Cooperative Ed. in Operatns Research & Info Syst	300	0	0%	1	5%	1	3%
Cooperative Field Experience	300	0	0%	1	5%	1	3%
Co-op I : Computer Operations	200	0	0%	1	5%	1	3%
Co-op II: Programming/Analysis	400	0	0%	1	5%	1	3%
Co-op Operations	200	1	8%	0	0%	1	3%
Co-op Programming	200	1	8%	0	0%	1	3%
Current Topics	400	0	0%	1	5%	1	3%
Data and File Structures	300	0	0%	1	5%	1	3%
Data Base Concepts	200	1	8%	0	0%	1	3%
Data Base Concepts	300	0	0%	1	5%	1	3%
Data Base Concepts and Facilities	300	0	0%	1	5%	1	3%
Data Base Concepts & Applications / dBASE	200	1	8%	0	0%	1	3%
Data Base Design	400	1	8%	1	5%	2	6%
Data Base Implementation	400	0	0%	1	5%	1	3%
Data Base Management Systems I	600	0	0%	1	5%	1	3%
Data Base Management(or DB Mgt Systems)	400	1	8%	6	29%	7	21%
Data Base Principles	400	0	0%	1	5%	1	3%
Data Base Processing(and Utilities)	200	3	23%	0	0%	3	9%
Data Base Program Development	300	0	0%	1	5%	1	3%
Data Base Program Development	300	0	0%	1	5%	1	3%
Data Base Systems	400	0	0%	2	10%	2	6%
Data Communications	200	0	0%	0	0%	0	0%
Data Communications and Networks	400	2	15%	1	5%	3	9%
Data Files and Data Bases	300	1	8%	0	0%	1	3%
Data Management Concepts	400	0	0%	1	5%	1	3%
Data Processing Policy and Management	400	0	0%	1	5%	1	3%
Data Processing Project	500	0	0%	1	5%	1	3%
Data Structures	500	0	0%	2	10%	2	6%
Data Structures	200	2	15%	2	10%	4	12%
Data Structures and Algorithms	200	0	0%	2	10%	2	6%
Data Structures and File Processing	300	0	0%	2	10%	2	6%
Decision Support and Expert Systems	400	0	0%	1	5%	1	3%
Decision Support Systems	400	2	15%	2	10%	4	12%
Design and Analysis of Algorithms	500	0	0%	1	5%	1	3%
Design and Anlys. of Algorithms&Data Structures	300	0	0%	1	5%	1	3%
Digital Computer Design	500	1	8%	1	5%	2	6%
Digital Image Processing	500	0	0%	1	5%	1	3%
Directed Studies in Computer Information Systems	200	0	0%	1	5%	1	3%
Directed Study	400	0	0%	2	10%	2	6%
Directed Study in Computer Science	400	0	0%	2	10%	2	6%
Discrete mathematical Structures	300	0	0%	1	5%	1	3%
Discrete Simulation	400	0	0%	1	5%	1	3%
Distributed Data Processing	400	0	0%	2	10%	2	6%
Distributed Systems I	500	0	0%	1	5%	1	3%
EDP Audit and Controls	400	0	0%	1	5%	1	3%
Electronic Instrumentation:Interfacing Technique	300	0	0%	1	5%	1	3%
Electronic Spreadsheet Applications (SS)	100	0	0%	1	5%	1	3%
Electronic Spreadsheets(Lotus SS)	200	2	15%	0	0%	2	6%
Elementary Programming Projects	200	0	0%	1	5%	1	3%
Evaluation & Application of Computer Hardeware	400	0	0%	1	5%	1	3%
Expert Systems Programming / LISP	400	1	8%	0	0%	1	3%

Fault-Tolerant Computer Architecture	600	0	0%	1	5%	1	3%
Field Experience	100	1	8%	0	0%	1	3%
File and Data Base Management	200	0	0%	1	5%	1	3%
File Manipulation Techniques	300	0	0%	1	5%	1	3%
Flowcharting and Structured Design	100	0	0%	0	0%	0	0%
FORTRAN for Business Applications	400	0	0%	1	5%	1	3%
FORTRAN IV	100	1	8%	1	5%	2	6%
FORTRAN Programming	200	1	8%	2	10%	3	9%
FORTRAN Prog. - Math Dept.	200	1	8%	1	5%	2	6%
FORTRAN(FORTRAN Programming,Comp Prog -)	300	3	23%	3	14%	6	18%
Fundamentals of Electronic Computers(general)	100	1	8%	0	0%	1	3%
Fundamentals of Pattern Recognition	400	0	0%	1	5%	1	3%
Graduate Research in Computer Science	500	0	0%	1	5%	1	3%
High Level Languages(4th gen A.I.)	200	1	8%	0	0%	1	3%
Honors Thesis	500	0	0%	1	5%	1	3%
IMS Data Base Coding	400	0	0%	1	5%	1	3%
IMS Data Base Design	200	0	0%	1	5%	1	3%
IMS Data Communication Coding	400	0	0%	1	5%	1	3%
IMS Programming I	200	2	15%	0	0%	2	6%
Independent Study	200	1	8%	4	19%	5	15%
Independent Study in Computer Science	400	0	0%	2	10%	2	6%
Information and Decision Support Systems I	400	0	0%	1	5%	1	3%
Information and Decision Support Systems II	400	0	0%	1	5%	1	3%
Information Center : Function & Mgt.	300	1	8%	0	0%	1	3%
Information Resource Management	400	0	0%	1	5%	1	3%
Information Resource Management	500	0	0%	1	5%	1	3%
Information Systems	200	1	8%	1	5%	2	6%
Information Systems Analysis and Design	300	0	0%	1	5%	1	3%
Information Systems Design and Projects	400	0	0%	1	5%	1	3%
Information Systems Design using COBOL	300	0	0%	1	5%	1	3%
Information Systems Programming & Installation	400	0	0%	1	5%	1	3%
Information Systems - Analysis and Design I	300	0	0%	2	10%	2	6%
Information Systems - Analysis and Design II	300	0	0%	1	5%	1	3%
Information Systm. for Decision Making(DB,WP,SS)	300	0	0%	1	5%	1	3%
Information Systm. Software Evaluation & Testing	400	0	0%	1	5%	1	3%
Internship	400	0	0%	4	19%	4	12%
Internship in Computer Science	300	0	0%	1	5%	1	3%
Intro BASIC for Business Applications	200	1	8%	1	5%	2	6%
Intro Microcmp Concpts for Teachers (uses BASIC)	500	0	0%	1	5%	1	3%
Intro to Algorithmic Techniques	300	0	0%	1	5%	1	3%
Intro to Artificial Intelligence Techniques	500	0	0%	1	5%	1	3%
Intro to Automata Theory	300	0	0%	1	5%	1	3%
Intro to Automata Theory, Lang. and Computation	400	0	0%	1	5%	1	3%
Intro to Business Appl. Programming (uses BASIC)	200	0	0%	1	5%	1	3%
Intro to Business Info Syst. (Lang. not listed)	200	0	0%	1	5%	1	3%
Intro to Business Telecommunications	200	1	8%	0	0%	1	3%
Intro to Computation Theory	400	0	0%	1	5%	1	3%
Intro to Computer Graphics	400	0	0%	1	5%	1	3%
Intro to Computer Info Systems (General)	100	1	8%	2	10%	3	9%
Intro to Computer Modeling and Simulation	500	0	0%	1	5%	1	3%
Intro to Computer Networking	500	0	0%	1	5%	1	3%
Intro to Computer Prog - COBOL I	100	1	8%	0	0%	1	3%
Intro to Computer Programming Using BASIC	100	0	0%	1	5%	1	3%
Intro to Computer Programming (logic, BASIC)	100	2	15%	0	0%	2	6%
Intro to Computer Programming(FORTRAN)	100	1	8%	1	5%	2	6%
Intro to Computer Progrming(No language listed)	200	2	15%	0	0%	2	6%

Intro to Computer Science I (uses PASCAL)	100	0	0%	2	10%	2	6%
Intro to Computer Science II (uses PASCAL)	100	0	0%	1	5%	1	3%
Intro to Computer Science III (uses PASCAL)	100	0	0%	1	5%	1	3%
Intro to Computer Science (Language not listed)	100	0	0%	1	5%	1	3%
Intro to Computer Software Usage (1 hr)	100	1	8%	0	0%	1	3%
Intro to Computer Systems(Int to Comptng. Syst.)	400	0	0%	2	10%	2	6%
Intro to Computers for Business and Industry	100	1	8%	0	0%	1	3%
Intro to Computers for the Home	100	1	8%	0	0%	1	3%
Intro to Computers (uses BASIC)	100	0	0%	1	5%	1	3%
Intro to Computers(or Intro to Comp Sci)	100	1	8%	4	19%	5	15%
Intro to Computing	100	0	0%	2	10%	2	6%
Intro to Computing (uses PASCAL)	100	0	0%	1	5%	1	3%
Intro to Comp. Processing Operations(Op. Traing)	200	0	0%	1	5%	1	3%
Intro to Comp. Science I (Language not listed)	100	0	0%	1	5%	1	3%
Intro to Comp. Science II (Language not listed)	100	0	0%	1	5%	1	3%
Intro to Data Base Mgt.(dBASE III+)	200	1	8%	0	0%	1	3%
Intro to Data Processing (Apps)	100	1	8%	1	5%	2	6%
Intro to Discrete Structures	200	0	0%	1	5%	1	3%
Intro to FORTRAN Programming	100	0	0%	1	5%	1	3%
Intro to Information Processing(Apps & BASIC)	100	0	0%	1	5%	1	3%
Intro to Information Systems	500	0	0%	1	5%	1	3%
Intro to Information Systems	300	0	0%	1	5%	1	3%
Intro to LISP Programming	100	1	8%	0	0%	1	3%
Intro to Management Science	300	0	0%	1	5%	1	3%
Intro to Microcomputers(SS,DB,WP)	300	0	0%	1	5%	1	3%
Intro to Microprocessors	400	0	0%	1	5%	1	3%
Intro to Modelling and Simulation	500	0	0%	1	5%	1	3%
Intro to Numerical Analysis	200	0	0%	1	5%	1	3%
Intro to Numerical Methods	400	0	0%	1	5%	1	3%
Intro to Operating Systems Software	300	0	0%	1	5%	1	3%
Intro to Pattern Recognition & Computer Vision	500	0	0%	1	5%	1	3%
Intro to Programming Languages (Lang not listed)	200	0	0%	1	5%	1	3%
Intro to Programming Languages (Survey several)	100	1	8%	0	0%	1	3%
Intro to Programming (Language not listed)	100	0	0%	1	5%	1	3%
Intro to Programming (uses PASCAL)	500	0	0%	1	5%	1	3%
Intro to System Design and Analysis	300	0	0%	1	5%	1	3%
Intro to Theoretical Computer Science	400	0	0%	1	5%	1	3%
Introductory Programming: ALGOL	300	0	0%	1	5%	1	3%
Introductory Programming: FORTRAN	300	0	0%	1	5%	1	3%
Issues in Computing & Society	400	0	0%	1	5%	1	3%
Job Control Language	200	1	8%	1	5%	2	6%
Languages II:Compiler Design & Construction	400	0	0%	1	5%	1	3%
Languages I:Survey of Charctr.& Implemntn Issues	300	0	0%	1	5%	1	3%
Large System Data Base	200	1	8%	0	0%	1	3%
Linear Programming	400	0	0%	1	5%	1	3%
Logic Circuit Design	300	0	0%	1	5%	1	3%
Logic of Programming	400	0	0%	1	5%	1	3%
LOGO	200	0	0%	1	5%	1	3%
Machine Architecture and Assembler Language	400	1	8%	0	0%	1	3%
Management Systems	300	0	0%	1	5%	1	3%
Mathematics for Computing	100	1	8%	0	0%	1	3%
Matrix Computation I	600	0	0%	1	5%	1	3%
Methods of Teaching Cmp Sci in Secondary Schools	300	0	0%	1	5%	1	3%
Micro Packages	100	1	8%	0	0%	1	3%
Microcomputer Applications	100	0	0%	1	5%	1	3%
Microcomputer Appltn. - Data Base Mgt. Syst.	100	1	8%	0	0%	1	3%

Microcomputer Appltn. - Electronic Filing	100	1	8%	0	0%	1	3%
Microcomputer Apptln. - Electronic Spreadsheet	100	2	15%	0	0%	2	6%
Microcomputer Architecture	300	1	8%	2	10%	3	9%
Microcomputer Database Concepts	100	1	8%	0	0%	1	3%
Microcomputer Designs and Applications	300	1	8%	1	5%	2	6%
Microcomputer Literacy	100	1	8%	0	0%	1	3%
Microcomputer Prog for Beginners(BASIC)	100	0	0%	0	0%	0	0%
Microcomputer Programming and Circuit Design	200	1	8%	1	5%	2	6%
Microcomputer Spreadsheet Concepts	100	1	8%	0	0%	1	3%
Microcomputer Systems and Applications	300	0	0%	1	5%	1	3%
Microprogrammed Computer Design	600	0	0%	1	5%	1	3%
Microprogramming(Microprocessors)	400	1	8%	1	5%	2	6%
Micros in Business	100	1	8%	0	0%	1	3%
Micro- FORTRAN	300	2	15%	0	0%	2	6%
Micro-Assembler Programming	300	2	15%	0	0%	2	6%
Micro-BASIC	100	1	8%	0	0%	1	3%
Micro-COBOL	400	1	8%	0	0%	1	3%
Micro-Computer Applications	100	4	31%	0	0%	4	12%
Micro-Data Base	100	1	8%	0	0%	1	3%
Micro-Decision Support	400	1	8%	0	0%	1	3%
Mini & Micro Computers (Architecture,etc.)	500	0	0%	1	5%	1	3%
Minicomputer Laboratory	400	0	0%	1	5%	1	3%
MS-DOS Commands	100	2	15%	0	0%	2	6%
Numerical Analysis I:Introductory Survey	400	0	0%	1	5%	1	3%
Numerical Linear Algebra	300	0	0%	1	5%	1	3%
On-Line Computer Applications	300	1	8%	0	0%	1	3%
On-Line Programming	400	0	0%	1	5%	1	3%
On-The-Job-Traiining	100	0	0%	0	0%	0	0%
Operating Systems	500	0	0%	4	19%	4	12%
Operating systems and Job Control	200	1	8%	0	0%	1	3%
Operating Systems Concepts	400	0	0%	1	5%	1	3%
Operating Systems I	300	0	0%	1	5%	1	3%
Operating Systems II	300	0	0%	2	10%	2	6%
Operating Systems - Math Dept	200	0	0%	1	5%	1	3%
Operating Systems(OS Concepts)	300	2	15%	1	5%	3	9%
Operating Systems/UNIX	200	2	15%	0	0%	2	6%
Operating Syst. and Computer Architecture	200	0	0%	1	5%	1	3%
Operations Research	400	0	0%	1	5%	1	3%
Optimization Theory	500	0	0%	1	5%	1	3%
Organization of Programming Languages	200	0	0%	0	0%	0	0%
PASCAL	200	0	0%	1	5%	1	3%
PASCAL for Business and Industry	100	0	0%	0	0%	0	0%
PASCAL for the Liberal Arts	100	0	0%	1	5%	1	3%
PASCAL Prog - Math Dept.	200	2	15%	0	0%	2	6%
PASCAL Programming(Intro to -)	200	2	15%	1	5%	3	9%
PC Operations I (Intro to use and DOS)	100	2	15%	0	0%	2	6%
PC Operations II (Use and more DOS)	100	1	8%	0	0%	1	3%
PL/I	200	0	0%	1	5%	1	3%
PL/I Programming I (Comp Prog -)	400	4	31%	4	19%	8	24%
PL/I Programming II	400	1	8%	0	0%	1	3%
Practical Applications on Microcomputers	100	1	8%	0	0%	1	3%
Practicum in Programming Languages(COBOL,FORTRAN	200	0	0%	1	5%	1	3%
Principles of BASIC Programming	100	1	8%	0	0%	1	3%
Principles of Business Computer Systems	100	2	15%	0	0%	2	6%
Principles of COBOL Programming	100	1	8%	0	0%	1	3%
Principles of Computer Graphics	200	0	0%	0	0%	0	0%

Principles of Computer Info. Systems (WP,DB,SS)	100	0	0%	1	5%	1	3%
Principles of Computer Programming/PASCAL	100	1	8%	0	0%	1	3%
Principles of Computer Science - Math Dept.	200	0	0%	1	5%	1	3%
Principles of Comp. Info. Processing(Prog & Apps	100	3	23%	0	0%	3	9%
Principles of Data Processing(general)	100	1	8%	1	5%	2	6%
Principles of Data-Base Management	400	0	0%	2	10%	2	6%
Principles of Natural Computing	500	0	0%	1	5%	1	3%
Principles of Programming Languages	200	0	0%	1	5%	1	3%
Principles of P. L.(ALGOL,PL/I,ADA,PASCAL,LISP)	500	0	0%	1	5%	1	3%
Principles of RPG Programming	100	1	8%	0	0%	1	3%
Principles of Structured Prog.(No Lang. Listed)	100	1	8%	0	0%	1	3%
Professional Conccerns for Computer Scientists I	200	0	0%	1	5%	1	3%
Professional Concerns for Computer Scientists II	400	0	0%	1	5%	1	3%
Professional Practice in Computer Science	400	0	0%	1	5%	1	3%
Program Correctness and Problem Specification	600	0	0%	1	5%	1	3%
Program Design and Development(BASIC)	100	1	8%	0	0%	1	3%
Programmimg Language Concepts	500	1	8%	1	5%	2	6%
Programming Languages for Educators	300	0	0%	1	5%	1	3%
Programming and Applications with Microcomputers	200	0	0%	1	5%	1	3%
Programming and Systems Techniques using RPG II	200	0	0%	1	5%	1	3%
Programming Applications I : RPG II	200	0	0%	1	5%	1	3%
Programming Applications II : COBOL	200	0	0%	1	5%	1	3%
Programming Applications III : PASCAL	300	0	0%	1	5%	1	3%
Programming in BASIC PLUS	200	0	0%	1	5%	1	3%
Programming in C'	300	2	15%	0	0%	2	6%
Programming in COBOL	200	0	0%	1	5%	1	3%
Programming in FORTRAN	200	0	0%	1	5%	1	3%
Programming Langs.:Procedural,Nonprcd. & 4th Gen	300	0	0%	1	5%	1	3%
Programming Language Concepts	400	0	0%	1	5%	1	3%
Programming Languages (Language not listed)	400	0	0%	3	14%	3	9%
Programming Languages(BASIC,FORTRAN,PASCAL)	300	0	0%	1	5%	1	3%
Programming Logic	100	1	8%	0	0%	1	3%
Programming Systems Design	500	0	0%	1	5%	1	3%
Programming Techniques	200	0	0%	1	5%	1	3%
Programming the Microcomputer for Teachers	500	0	0%	1	5%	1	3%
Programming with PL/I	200	0	0%	1	5%	1	3%
Programming with 'C'(C' Prog.)	200	1	8%	0	0%	1	3%
Programminng in BASIC	100	0	0%	1	5%	1	3%
Progrm. Lang.(PASCAL,ALGOL,PROLOG,LOGO,FORTRAN)	300	0	0%	1	5%	1	3%
Quantative Computer Methods	200	1	8%	0	0%	1	3%
Quantitive Methods for Management	200	0	0%	1	5%	1	3%
Reading and Research	500	0	0%	1	5%	1	3%
Report Program Generator	200	0	0%	1	5%	1	3%
Robotics Applications	300	0	0%	1	5%	1	3%
RPG II - Advanced RPG II	200	3	23%	0	0%	3	9%
RPG III	200	1	8%	1	5%	2	6%
RPG II(RPG)	100	4	31%	1	5%	5	15%
RPG Programming I	200	2	15%	2	10%	4	12%
RPG Programming II	200	3	23%	0	0%	3	9%
Scientific Programming in FORTRAN 77	200	0	0%	1	5%	1	3%
Scientific Programming (uses FORTRAN)	500	0	0%	1	5%	1	3%
Selected Research Topics in Computer Science	400	0	0%	1	5%	1	3%
Seminar and Project Design for educators	400	0	0%	1	5%	1	3%
Seminar in Systems Design	300	2	15%	0	0%	2	6%
Senior Thesis	500	0	0%	1	5%	1	3%
Simualtion of Discrete Event Systems	500	0	0%	1	5%	1	3%

Simulation of Continuous Systems	500	0	0%	1	5%	1	3%
Simulation Using FORTRAN	300	0	0%	1	5%	1	3%
Small Computer Appl. Software(DB, SS, WP)	200	1	8%	0	0%	1	3%
Small Computer Systems Architecture	200	1	8%	0	0%	1	3%
Software and Hardware Concepts	300	0	0%	1	5%	1	3%
Software and Hardware Selection & User Training	400	1	8%	0	0%	1	3%
Software Applications II (Business Software)	300	1	8%	0	0%	1	3%
Software Applications (Survey types of apps)	100	2	15%	0	0%	2	6%
Software Desing and Programming Techniques	200	0	0%	1	5%	1	3%
Software Engineering	400	0	0%	2	10%	2	6%
Software Engineering I	400	0	0%	1	5%	1	3%
Software Engineering II	400	0	0%	1	5%	1	3%
Software Engineering Principles	400	0	0%	1	5%	1	3%
Software Systems Development	500	0	0%	1	5%	1	3%
Software Tools(WP,DB,SS)	100	0	0%	0	0%	0	0%
Special Problems	300	0	0%	1	5%	1	3%
Special Projects in Computer Science	400	0	0%	1	5%	1	3%
Special Studies	400	0	0%	1	5%	1	3%
Special Topics	300	0	0%	2	10%	2	6%
Special Topics in Computer Information Systems	200	0	0%	1	5%	1	3%
Special Topics in Computer Science	500	0	0%	2	10%	2	6%
Special Topics in Computer Science	400	0	0%	4	19%	4	12%
Special topics in Computer Science for Education	500	0	0%	1	5%	1	3%
SPSS : Computerized Analysis for Research	100	0	0%	1	5%	1	3%
Structured COBOL	100	0	0%	1	5%	1	3%
Structured COBOL Programming I	200	0	0%	1	5%	1	3%
Structured COBOL Programming II	200	0	0%	1	5%	1	3%
Structured COBOL Programming III	200	0	0%	1	5%	1	3%
Structured Program Design	300	0	0%	1	5%	1	3%
Structured Program Design (Lang not listed)	200	0	0%	1	5%	1	3%
Structured Programming in BASIC	100	1	8%	0	0%	1	3%
Structured Programming in COBOL	200	0	0%	1	5%	1	3%
Structured Programming With PASCAL	100	1	8%	0	0%	1	3%
Structures of Compilers I	600	0	0%	1	5%	1	3%
Survey of Computer Science	500	0	0%	1	5%	1	3%
Survey of Computing	100	0	0%	1	5%	1	3%
Survey of Modern Programming Languages	100	1	8%	0	0%	1	3%
Switching Theory	400	0	0%	1	5%	1	3%
System Analysis and Design Workshop I	400	0	0%	1	5%	1	3%
System Analysis and Design Workshop II	400	0	0%	1	5%	1	3%
System Simulation	300	0	0%	1	5%	1	3%
Systems Analysis	100	1	8%	2	10%	3	9%
Systems Analysis and Design II	200	1	8%	0	0%	1	3%
Systems Analysis and Design (I)	200	2	15%	3	14%	5	15%
Systems Design	400	0	0%	1	5%	1	3%
Systems Developeamt II (apply first course)	200	1	8%	0	0%	1	3%
Systems Development I/& Design(Syst. Analyst.)	200	1	8%	0	0%	1	3%
Systems Development Methods (Syst. Analyst)	200	2	15%	0	0%	2	6%
Systems Development Project	400	1	8%	0	0%	1	3%
Systems I (Business Systems)	100	1	8%	0	0%	1	3%
Systems II (Systems Analyst)	200	1	8%	0	0%	1	3%
Systems Implemenatation	400	0	0%	1	5%	1	3%
Systems Management	400	0	0%	1	5%	1	3%
Systems Organization and Analysis	400	0	0%	1	5%	1	3%
Systems Programming	400	0	0%	1	5%	1	3%
Systems Programming Concepts	200	0	0%	1	5%	1	3%

Systems Programming II	300	0	0%	1	5%	1	3%
Systems Programming I(Assembler, C')	300	0	0%	1	5%	1	3%
Systems Programming/ C'	200	1	8%	0	0%	1	3%
Systems Software	300	0	0%	1	5%	1	3%
SYS/36 Operations I	100	1	8%	0	0%	1	3%
SYS/36 Operations II	100	1	8%	0	0%	1	3%
Teaching of Computer Science	200	0	0%	1	5%	1	3%
Teaching of Secondary School Computer Science	400	0	0%	1	5%	1	3%
Telecomminications	200	1	8%	0	0%	1	3%
Telecommunications and Teleprocessing	400	0	0%	1	5%	1	3%
Theory of Adaptable Systems	600	0	0%	1	5%	1	3%
Theory of Computation	500	0	0%	3	14%	3	9%
Theory of Computer Graphics	500	0	0%	1	5%	1	3%
Theory of Computing	300	0	0%	1	5%	1	3%
Thesis	400	0	0%	1	5%	1	3%
Topics	400	0	0%	1	5%	1	3%
Topics in Computer and Information Science	400	0	0%	1	5%	1	3%
Topics in Computer Information Systems	500	0	0%	1	5%	1	3%
Topics in Computer Science	300	0	0%	2	10%	2	6%
UNIX Operating System/ C' Language	100	1	8%	0	0%	1	3%
Utility Routines and Operating Systems	400	1	8%	0	0%	1	3%
Work Experience	200	1	8%	0	0%	1	3%

Attachment #2.B

Analysis of Course Offerings By Type of school

Notes:
1) Any classes listed as Data Entry or Keyboarding classes were not included in the survey
2) The Level catagory is listed only as a guide. The 100 etc. comes from the course number listed in the catalog. In cases like Computer Graphics that are offered in several levels they were grouped into a high and a low level.

TERMS LISTED BY TOTAL COUNT

Classes that have the string:	2 yr sch. count	2 yr avg/sch	4 yr count	4 yr avg/sch	Grand total count	Grand total avg/sch
COBOL	26	2.00	30	1.43	56	1.65
Appl	22	1.69	32	1.52	54	1.59
BASIC	28	2.15	16	0.76	44	1.29
Micro	29	2.23	15	0.71	44	1.29
Data Base	12	0.92	19	0.90	31	0.91
PASCAL	9	0.69	22	1.05	31	0.91
FORTRAN	11	0.85	19	0.90	30	0.88
Analysis	6	0.46	22	1.05	28	0.82
Operating Sys	7	0.54	16	0.76	23	0.68
RPG	17	1.31	6	0.29	23	0.68
Assem	9	0.69	11	0.52	20	0.59
PL/I	6	0.46	7	0.33	13	0.38
SS	7	0.54	6	0.29	13	0.38
Data Stru	2	0.15	10	0.48	12	0.35
Structured	3	0.23	9	0.43	12	0.35
Architecture	5	0.38	5	0.24	10	0.29
C'	8	0.62	1	0.05	9	0.26
Decision	3	0.23	6	0.29	9	0.26
Graphics	1	0.08	8	0.38	9	0.26
Network	2	0.15	5	0.24	7	0.21
Edu	0	0.00	6	0.29	6	0.18
IMS	2	0.15	3	0.14	5	0.15
Intell	0	0.00	5	0.24	5	0.15
Distributed	0	0.00	4	0.19	4	0.12
APL	0	0.00	3	0.14	3	0.09
Expert	1	0.08	1	0.05	2	0.06
UNIX	1	0.08	0	0.00	1	0.03

Atachment #2.C

Listing of key strings by type of school

List by total count	List by 2 year count	List by 4 year count
COBOL	Micro	Appl
Appl	BASIC	COBOL
BASIC	COBOL	Analysis
Micro	Appl	PASCAL
Data Base	RPG	Data Base
PASCAL	Data Base	FORTRAN
FORTRAN	FORTRAN	BASIC
Analysis	Assem	Operating Sys
Operating Sys	PASCAL	Micro
RPG	C'	Assem
Assem	Operating Sys	Data Stru
PL/I	SS	Structured
SS	Analysis	Graphics
Data Stru	PL/I	PL/I
Structured	Architecture	Decision
Architecture	Decision	Edu
C'	Structured	RPG
Decision	Data Stru	SS
Graphics	IMS	Architecture
Network	Network	Intell
Edu	Expert	Network
IMS	Graphics	Distributed
Intell	UNIX	APL
Distributed	APL	IMS
APL	Distributed	C'
Expert	Edu	Expert
UNIX	Intell	UNIX

Attachment #3.A

Program Requirements Survey - Results by Topic

Listed by order of total number of schools requiring a given topic

# Programs =	49			Two year Programs :			Four year Programs		
	Total number of schools requiring:	% of all schools listed	# classes required per school	Number offered =		22	Number offered =		27
TOPIC				# schools requiring	% 2 year schools	# classes / school	# schools requiring	% 4 year schools	# classes / school
COBOL	36	73.5%	1.67	17	77.3%	1.71	19	70.4%	1.63
Electives	36	73.5%	2.39	15	68.2%	1.87	21	77.8%	2.76
Sys Anl/Develop	32	65.3%	1.78	15	68.2%	1.40	17	63.0%	2.12
Into Concepts	30	61.2%	1.00	19	86.4%	1.00	11	40.7%	1.00
Data Base	26	53.1%	1.15	11	50.0%	1.09	15	55.6%	1.20
Oper Systm	23	46.9%	1.04	8	36.4%	1.00	15	55.6%	1.07
Other Classes	22	44.9%	1.41	4	18.2%	1.00	18	66.7%	1.50
Data Structures	15	30.6%	1.27	1	4.5%	1.00	14	51.9%	1.29
Int Prg-PASCAL	14	28.6%	1.00	3	13.6%	1.00	11	40.7%	1.09
RPG	14	28.6%	1.21	11	50.0%	1.27	3	11.1%	1.00
ASSEMBLER	13	26.5%	1.00	2	9.1%	1.00	11	40.7%	1.00
BASIC	13	26.5%	1.08	9	40.9%	1.11	4	14.8%	1.00
Prog Desgn/Logic	13	26.5%	1.00	5	22.7%	1.00	8	29.6%	1.00
Prog Langs	12	24.5%	1.00	1	4.5%	1.00	11	40.7%	1.00
Adv/Con't Prog	10	20.4%	1.10	3	13.6%	1.00	7	25.9%	1.14
Coop/Work Exp	10	20.4%	1.10	6	27.3%	1.00	4	14.8%	1.25
Int Prg-lg not 1	10	20.4%	1.00	6	27.3%	1.00	4	14.8%	1.00
FORTRAN	9	18.4%	1.22	3	13.6%	1.00	6	22.2%	1.33
Sys Org/Archit.	8	16.3%	1.00	2	9.1%	1.00	6	22.2%	1.00
Data Com	7	14.3%	1.00	3	13.6%	1.00	4	14.8%	1.00
Micro/Apps	7	14.3%	1.29	5	22.7%	1.40	2	7.4%	1.00
Operations	7	14.3%	1.86	6	27.3%	2.00	1	3.7%	1.00
C	4	8.2%	1.25	3	13.6%	1.33	1	3.7%	1.00
Int Prg-BASIC	4	8.2%	1.00	2	9.1%	1.00	2	7.4%	1.00
Keyboard	4	8.2%	1.00	2	9.1%	1.00	2	7.4%	1.00
PASCAL	3	6.1%	1.00	1	4.5%	1.00	2	7.4%	1.00
PL/I	3	6.1%	1.00	2	9.1%	1.00	1	3.7%	1.00
SS/DB	3	6.1%	1.00	2	9.1%	1.00	1	3.7%	1.00
Graphics	2	4.1%	1.00	1	4.5%	1.00	1	3.7%	1.00
Decision/Expert	1	2.0%	1.00	0	0.0%	0.00	1	3.7%	1.00
APL	0	0.0%	0.00	0	0.0%	0.00	0	0.0%	0.00

Attachment #3.B

Survey of Requirements
Listed by type of program

Key terms ordered by all schools	Key terms ordered two year schools	Key terms ordered by four year schools
COBOL	Into Concepts	Electives
Electives	COBOL	COBOL
Sys Anl/Develop	Electives	Other Classes
Into Concepts	Sys Anl/Develop	Sys Anl/Develop
Data Base	Data Base	Data Base
Oper Systm	RPG	Oper Systm
Other Classes	BASIC	Data Structures
Data Structures	Oper Systm	ASSEMBLER
Int Prg-PASCAL	Coop/Work Exp	Int Prg-PASCAL
RPG	Int Prg-lg not lst	Into Concepts
ASSEMBLER	Operations	Prog Langs
BASIC	Micro/Apps	Prog Desgn/Logic
Prog Desgn/Logic	Prog Desgn/Logic	Adv/Con't Prog
Prog Langs	Other Classes	FORTRAN
Adv/Con't Prog	Adv/Con't Prog	Sys Org/Archit.
Coop/Work Exp	C	BASIC
Int Prg-lg not lst	Data Com	Coop/Work Exp
FORTRAN	FORTRAN	Data Com
Sys Org/Archit.	Int Prg-PASCAL	Int Prg-lg not lst
Data Com	ASSEMBLER	RPG
Micro/Apps	Int Prg-BASIC	Int Prg-BASIC
Operations	Keyboard	Keyboard
C	PL/I	Micro/Apps
Int Prg-BASIC	SS/DB	PASCAL
Keyboard	Sys Org/Archit.	C
PASCAL	Data Structures	Decision/Expert
PL/I	Graphics	Graphics
SS/DB	PASCAL	Operations
Graphics	Prog Langs	PL/I
Decision/Expert	APL	SS/DB
APL	Decision/Expert	APL

Attachment #4.A

Transfer Credit Analysis

Notes:

1) This data comes from the Transfer Booklets in the Royal Oak Counseling Office in December 1988. Some of the material in the books does not reflect our 'NEW' courses of 106, 108, etc..
2) Just because a school states that it will accept a class that does not mean that a department WILL accept the class as a way to fulfill a requirement.
3) The acceptability of a class for transfer must be looked at on a department by department basis, not just on a school basis. However this is the best data available without trying to contact each department of each school independently.
4) The codes below stand for:

CLS = Transfers directly as a comparable class, full credit
GC = Transfers as a General Education Credit
CSC = Transfers as a Computer Science Credit, not as a class
BSC = Transfers as a Business Class Credit, not as a class
= Blank, not reviewed in the transfer list
NC = No Credit, does not transfer

O.C.C Class Number

College	103	106	108	112	115	120	125	190	203	205	215	216	220	245	253	263	280	281	282	283	28
Adrian					CLS	CLS	CLS				CLS										
CMU	CLS	GC	GC	CSC	CLS	CLS	CLS	CSC	CSC	GC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC
EMU	CLS1	GC	GC	CLS1	CLS1	GC	GC	GC	CLS	GC	CLS	GC	GC	CLS	GC	GC	GC	GC	GC	GC	GC
Grand Valley	CLS	CSC	CSC	CSC	CLS	CSC	CLS	CSC	CSC	CSC	CLS	CSC	CSC	CSC	CSC	CSC	CLS	CSC	CSC	CSC	CSC
Lawrence Ins.	CLS			GC	CLS	GC	GC	GC	CLS	GC	CLS	GC	GC	CLS	GC	GC	GC	CLS	GC	GC	GC
LSS	CLS			CSC	CSC	CSC	CSC	CSC	CLS	CSC	CLS	CLS	CSC	CLS	CLS	CSC	CSC	CSC	CSC	CSC	CSC
Madonna	CLS	GC	GC	GC	CLS	CLS	CLS	GC	GC	CLS	GC	GC	GC	GC	GC	GC	GC	GC	GC	GC	GC
Marygrove	CLS			CSC	CLS	CSC	CSC	CSC	CSC	CSC	CLS	CLS	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CS
Mercy Col.	GC			GC	CLS	GC	CLS	GC	GC	GC	CLS	GC	GC	CLS	GC	GC	GC	CLS	GC	GC	GC
MSU	CLS3			CLS	CLS	CLS			CSC		CLS	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CS
MTU	NC	NC	NC	CLS	CLS	NC	NC	NC	NC	NC	CLS	NC	NC	CLS	NC	NC	NC	NC	NC	NC	NC
NMU	CLS	GC	GC	GC	GC	GC	GC	GC	CLS	GC	CLS	CLS	CLS	CLS	GC	GC	GC	CLS	CLS	GC	GC
Oakland Univ	NC			CLS	CLS	CSC	CSC	CLS	CSC	CSC	CLS	CLS	CLS	CLS	CSC	CSC	CSC	CLS	CSC	CSC	CLS
Saginaw Vly.	CSC			CSC	CLS	CSC	CSC	CSC	CSC	CLS	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC
St. Marys	GC	GC	GC	GC	CLS	CLS	GC	GC	GC	GC	CLS	GC	GC	GC	GC	GC	GC	GC	GC	GC	GC
U of D	CLS			GC	CLS	GC	GC	GC	CLS	GC	CLS	CLS	CLS	CLS	GC	GC	GC	GC	GC	GC	GC
UM Ann Arbor	NC	NC	NC	NC	CLS	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
UM Dearborn	NC			CLS	CLS	CSC	CSC		CSC	NC	CLS	CLS	CSC	CSC	NC	CSC	CSC	CSC	CSC	CSC	NC
UM Flint	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC	CSC
Walsh	CLS2			CLS2					CLS		CLS			CLS							
WMU	CLS	NC	CSC	BSC	CLS	BSC	CSC	NC	CLS	CSC	CLS	BSC	BSC	CLS	BSC	CSC	CSC	BSC	BSC	BSC	CSC
# Schools =	21																				
Total Classes	9	0	0	4	16	5	5	1	7	2	16	6	3	10	1	0	1	4	1	0	1
% of schools	43%	0%	0%	19%	76%	24%	24%	5%	33%	10%	76%	29%	14%	48%	5%	0%	5%	19%	5%	0%	5

CLS1 = Credit given only for 103 AND 115 or 103 AND 203 or 112 AND 103
CLS2 = Credit given for 103 AND 112
CLS# = Credit given for 103 AND 115

Attachment #4.B

Analysis of Transfer Credits
Listed by number of schools accepting an OCC class directly

OCC Class	Code	# Schools Accepting	% Schools Accepting
COBOL I	215	16	76%
FORTRAN	115	16	76%
COBOL II	245	10	48%
Princp CIP	103	9	43%
Info Systems	203	7	33%
PL/I	216	6	29%
Assembler I	120	5	24%
BASIC	125	5	24%
Data Structures	281	4	19%
Princp Stru Pg	112	4	19%
Assembler II	220	3	14%
Small Syst Soft	205	2	10%
Comp Architect.	282	1	5%
High Level Lang	280	1	5%
Quant Methds	253	1	5%
Small Comp Arch	285	1	5%
UNIX/C	190	1	5%
Advncd Info Sys	283	0	0%
Applications	263	0	0%
Database	108	0	0%
Spreadsheets	106	0	0%

APPENDIX C

DON MANN

ANALYSIS OF
9/27/87 WANT ADS
DETROIT NEWS

1.1 CIS Ads Analyzed:

# ADS	AD TITLE
36	Programmer/Analyst
4	Analyst/Programmer
3	Data Processing
1	Analyst
1	Computer Applications Developer
1	Computer Professional
1	Data Processor
1	D/P Professionals
1	EDP
1	Electronic Systems Personnel
1	Programmer
51	TOTAL CIS ADS

1.2 Frequency Analysis of Words/Phrases in CIS Ads:

103 OCCURENCES, PROGRAMMING LANGUAGES: CICS (26), COBOL (23), RPG II (11), RPG III (10), PL/I (10), UNIX/C (7), Fortran (5), Assembler (5), BASIC (2), VSAM (3), VTAM (1)

32 OCCURENCES, DATA BASE / DATA COMMUNICATIONS: IBM DB/DC (12), DB 2 (15), DBMS (2), DATA COMM / DB (1), NDB 2 (1), Data Base (1)

28 OCCURENCES, INFORMATION MANAGEMENT SYSTEMS: IMS (21), IDMS/ADSO (4), IDMS-R (1), IDMS (1), DMS II (1)

26 OCCURENCES, FOURTH GENERATION LANGUAGES: FOCUS (11), ORACLE (5), DL 1 (4), SAS (2), SQL (1), RAMIS (1), DBASE III (1), Fourth Generation (1)

17 OCCURENCES, SPECIFIC HARDWARE: IBM PC Knowledge (7), VAX (5), DEC (1), PDP (1), HP 3000 (1) SERIES 1 (1), IBM AT (1)

14 OCCURENCES, OPERATING SYSTEMS: OS/MVS (4), DOS/VSE (4), OS/VS (1), MVS (1), TSO (1), VM/CMS (1), EXEC II (1), JES II (1)

The following words/phrases were mentioned once in the 51 ads: Accounting knowledge, ADABAS/NATURAL, ADR/Data Comm, Baseway, CNC, COGEN, DISSOS, EDX/EDL, HOGAN, IDEAL, IMAGE, LINC, Mantis, MTS, Panvalet, Pathway, Powerhouse, SDA, STRATUS, Symphony, TAL, Tandem, TOTAL, Tower, and Transact.

2.1 OIS Ads Analyzed:

# ADS	AD TITLE
22	Secretary
11	Legal Secretary
11	Clerk-Typist
9	Word Processing
7	Typist
5	Executive Secretary
5	Clerical
5	Sales Secretary
5	General Office
3	Administrative Assistant
3	Keypunch, Keytape Operator
2	Administrative Secretary
2	Customer Service
2	Data Entry
1	Confidential Secretary
1	Coordinator/Administrator
1	Department Secretary
1	General Secretary
1	Health Care Secretary
1	Hotel Secretary
1	Legal Assistant
1	Legal Biller
1	Managers Secretary
1	Office Administrator
1	Office Manager
1	Office Work
1	Senior Administrative Assistant
105	TOTAL OIS ADS

2.2 Frequency Analysis of Words/Phrases in OIS Ads:

90 OCCURENCES, WORD PROCESSING/COMPUTER SKILLS: Word Processing Knowledge (23), Computer Experience (12), Data Entry (9), IBM PC (6), WordStar (6), DisplayWriter (5), PC Experience (4), Wang (4), WordPerfect (4), CRT Experience (3), 10,000 KSH (2), IBM Knowledge (2), IBM Word Processor (2), IBM PC AT (2), MultiMate (2), EDP Skills (1), WheelWriter (1), Microsoft (1), Verifying Terminal (1)

78 OCCURENCES, TYPING SKILLS: Good Typing Skills (28), Light Typing (1), Type 35 WPM (1), Type 45 (3), Type 50 (15), Type 55 (8), Type 60 (11), Type 65 (1), Type 70 (4), Type 80 (2), IBM 5520 (1), Xerox 8010 (1), Electronic Typewriter (1), Statistical Typing (1)

25 OCCURENCES, COMMUNICATION SKILLS: Good Communication Skills (16), Strong Communication Skills (4), Good Spelling & Grammar Skills (5)

23 OCCURENCES, SHORTHAND/DICTATION: Good Shorthand (12), Shorthand 60 WPM (2), Dictation (1), Dictation 70 (1), Shorthand 70 (2), Shorthand 80 (1), Shorthand 90 (2), Dictation Equipment Operation (2)

22 OCCURENCES, ORGANIZATIONAL SKILLS: Strong Organizational Skills (17), Filing Skills (3), Office Procedures Knowledge (1), Clerical Skills (1)

15 OCCURENCES, TELEPHONE SKILLS: Good Phone Communication Skills (13), Pleasant Telephone Personality (2)

11 OCCURENCES, ACCOUNTING KNOWLEDGE: Bookkeeping Knowledge (8), Accounting Knowledge (3)

10 OCCURENCES, LEGAL KNOWLEDGE: Legal Experience (3), Litigation Experience (3), Medical Malpractice Experience (2), Legal Secretary Knowledge (1), Legal Assistant Certificate Required (1)

8 OCCURENCES, GOOD WITH FIGURES: Good with figures (6), Good math skills (1), Good with arithmetic (1)

6 OCCURENCES, APPLICATION KNOWLEDGE: Real Estate Knowledge (3), Marketing Background (2), Banking Knowledge (1)

5 OCCURENCES, SPREADSHEET KNOWLEDGE: Lotus 1-2-3 (4), Spreadsheet (1)

5 OCCURENCES, PROFESSIONAL IMAGE: Professional Image (5)

2 OCCURENCES, PROOFREADING: Proofreading Skills (2)

The following words/phrases were mentioned once in the 105 ads: Entrex, Inforex, International Correspondence Knowledge, Tarten, 10-Key Calculator

G.A.M. Executive Search, Inc.
Bingham Office Park
30400 Telegraph Road, Suite 322
Birmingham, Michigan 48010
(313) 258-0343

October 2, 1987

Mr. Donald Mann, Instructor
Computer Science Department
OAKLAND COMMUNITY COLLEGE
27055 Orchard Lake Road
Farmington Hills, Michigan 48018

Dear Don,

G.A.M. Executive Search, Inc. is happy to accommodate your request for a statement of what we feel, as placement specialists, would be necessary requirements for entry-level graduates to enter the job market.

COMPUTER SCIENCE CURRICULUM
Just having the degree complete is not the major importance to employers today--they are looking at the specific classes taken. Ninety percent of our openings are in COBOL shops, and these employers are looking for applicants to have taken COBOL I and COBOL II. We are starting to see an increase in the "C" shops combined with UNIX as the micro world continues to grow. We always advise our entry-level candidates to take along to the interview one of their school projects that is most applicable to the job opening. Candidates that have had classes keying in on DATABASE structures and design are usually seen more favorably.

SECRETARIAL/OFFICE INFORMATION SYSTEMS CURRICULUM
Employers are looking for an emphasis in the following areas: Word Processing (65 w.p.m. as a minimum), Spreadsheet Analysis (ie. Lotus 1,2,3), Excellent Written Communication Skills (they are usually tested in spelling & grammar), Poised Verbal Communication (in phone skills and meeting the public).

We have had an extremely high ratio of placing entry-level graduates from Oakland Community College. Since all of our openings are "EMPLOYER PAID FEES", it takes a very special candidate to make the employer want to pay a fee (usually in the $2,000 - $4,000 range) for an entry-level candidate.....but it has been done time and time again.

C-23

Each graduate's academic background is certainly important; however, it does not solely get the job. Interviewing is an art, and as we know there's always competition. Normally, the candidate that interviewed the best--gets the job. When these graduates come to us initially, after they are determined to be technically competent for the opening, they are briefed specifically on the opening, company, employer, and how to be an effective interviewee. We educate them on eye contact, dressing properly, communicating with the employer, and how to ask for the job.

I really believe Don, our success in placing O.C.C. graduates comes from our marketing of candidates directly with hiring authorities. These new graduates are usually mass mailing resumes (along with hundreds of other recent graduates) to companies that never get to a hiring authority. We rarely are sending resumes (only if an interview has been confirmed) as a courtesy to our client.

Our placement of your students has been 100% in computer positions because of our relationship, but I hope that O.C.C. will consider referring the Secretarial/O.I.S. graduates to G.A.M. for placement. Our Office Support Division at G.A.M. is having tremendous success in placing good, qualified entry-level candidates.

We look forward to strengthening our relationship with Oakland Community College. If I can be of any further assistance in your curriculum program, please don't hesitate to contact me.

Sincerely,

PAM ANDERSON, Vice-President
G.A.M. Executive Search, Inc.

PA/jlr

C-24

C-[illegible]25

	CIS	CSci	RPG	Pascl-3rd	'C'-3rd	DB-4th	Objct-4th	AI-5th	PC pkg	Large TC	PC TC	OS/JCL	Large	PC
OCC-now		1		1	1	1			1				1	1
OCC-prop	1				1	1		1	1	1	1	1	1	1
Macomb	1		1		1	1			1	1		1	1	1
Henry Ford	1		1			1						1	1	
Lansing		1	1	1	1	1		1	1	1			1	1
Schoolcraft	1		1	1	1	1			1				1	
Delta	1		1			1			1				1	1
Monroe			1	1		1							1	
Jackson		1	1	1		1							1	1
Cuyahoga-OH			1	1		1			1	1	1		1	1
Dallas-Tx	1		1	1	1	1				1		1	1	1
DeAnza-Ca	1	1		1	1	1	1	1	1	1	1	1	1	1
Maricopa-Az														
Johnson-Ka		1	1		1	1		1	1	1	1	1	1	1
Miami-Fl	1		1	1		1			1	1		1	1	
Monroe-NY	1	1	1			1			1		1	1	1	
Moraine-Ill	1		1	1		1			1				1	1
Totals	9	5	13	9	6	14	1	3	10	7	4	7	14	9

| COURSE DESIGNATION | - - - - - - - - COURSES - - - - - - - - - - - | COMPUTER ENVIRONMENT

SISTER INSTITUTION ANALYSIS

H. AUSTIN

Appendix D

Report on the surveys of ex-DPR students and county employers

DPR Ex-student survey

Research goals

1. Assess student rationale for starting and stopping coursework.
2. Assess student evaluation of coursework.
3. Examine employment patterns.
4. Examine fit between coursework and computer specialist employment.

Sample Selection

1. Enrolled in 1985-86 schoolyear.
2. Not enrolled in 1986-87 schoolyear.
3. Successful completion of two DPR courses at the 200 level.

Data collection

1. 215 surveys mailed; phone follow-up a week later.
2. 53 surveys returned.

Data analysis

1. Univariate and cross-tabulation bivariate analysis; low N precluded more powerful statistics.
2. Chart graphics of cross-tabs.

Oakland County Employer Survey

Research goals

1. Assess hardware and system software environments; vendor, size, operating system etc.
2. Assess communication architecture.
3. Examine application software practices; make vs. buy, languages, packages etc.
4. Examine computer end-user practices; batch vs. terminals, level of expertise etc.
5. Assess need projections for computer specialists.

Sample selection

1. Sample of Oakland county employers from the Oakland County Economic Development Office.
2. Sub-sample selected from OCED original based on SIC codes of industries tending to employ computer specialists; SIC codes from analysis of MESC data (N=305).
3. Another sample of mainframe employers from a local association of same (N=30).

Data collection

1. 335 surveys mailed, no follow-up.
2. 54 returned; 49 from OCED sample, 5 from local mainframe association sample.

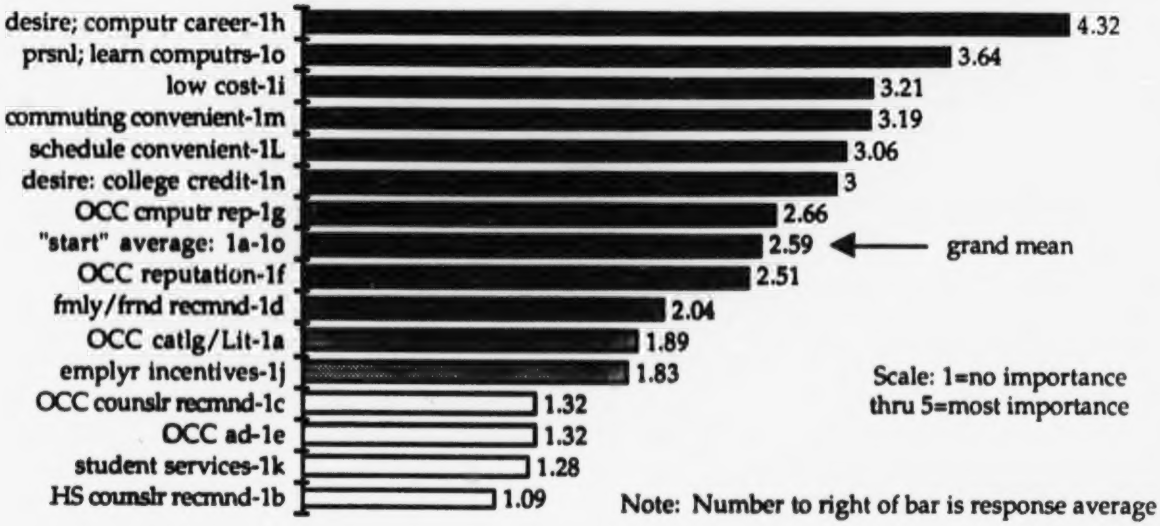
Data analysis

1. Univariates and bivariate cross-tabulations; small N precludes more powerful statistics.
2. Chart graphs of cross-tabs.

Survey Findings:

The findings are presented in chart form with comments for both surveys. The first eight charts present the findings from the ex-student survey. The remaining charts as well as part of the eigth chart present the findings from the employer survey. The findings conclude with a summary and recommendations.

N=53 **Chart 1: "Reasons for starting coursework" ranking by ex-students**



Scale: 1=no importance thru 5=most importance

Note: Number to right of bar is response average

Charts1-7 display the results from a survey of ex-DPR students. Charts 1-3 denote ex-student opinion of their OCC DPR coursework, chart 4 shows the employment pattern for these students and charts 5-7 displays the opinions of computer-employed ex-students about the OCC DPR program. The selection characteristics for the ex-student sample were last attendance in the 1985-86 school year and completion of at least two DPR courses at the 200 level.

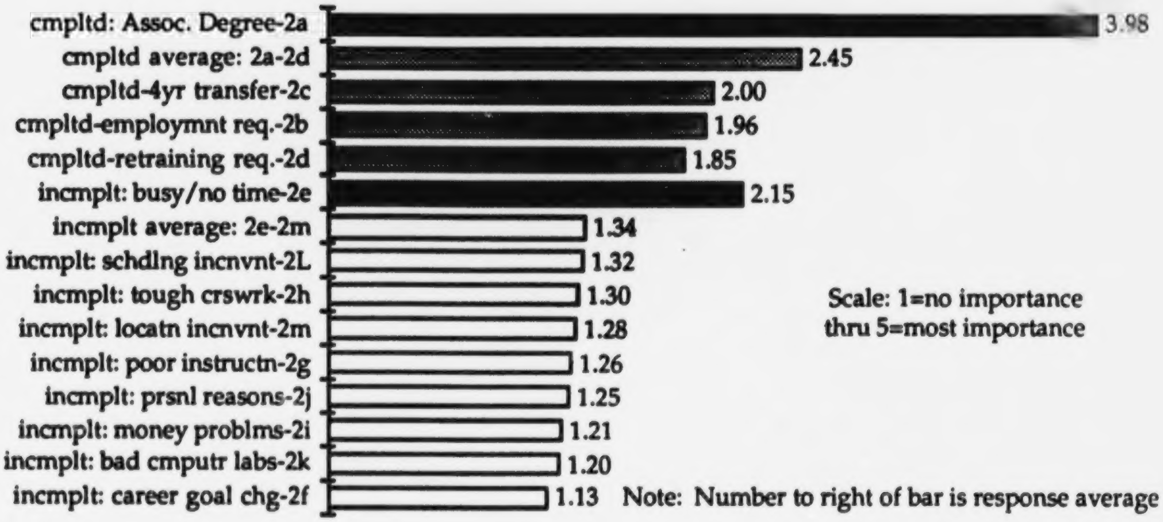
Chart 1 displays the response averages from a series of items about reasons for starting computer coursework at OCC. Desire for a career in computing along with a personal decision to learn about computers were the reasons ranked highest in importance. The traditional community college inducements of low cost and the convenience of both commuting and class schedules were also important factors.

Motivators of moderate importance included the reputations of both the OCC computer program and of the entire OCC institution along with recommendations from family and/or friends.

The least important reasons for starting coursework were reported as counselor recommendations, student services and OCC literature and advertisements.

These findings suggest that for this sample, the motivating rationales were primarily internal; they wanted to learn computing and chose OCC primarily on the basis of cost and convenience.

N=53 **Chart 2: "Reasons for stopping coursework" ranking by ex-students**



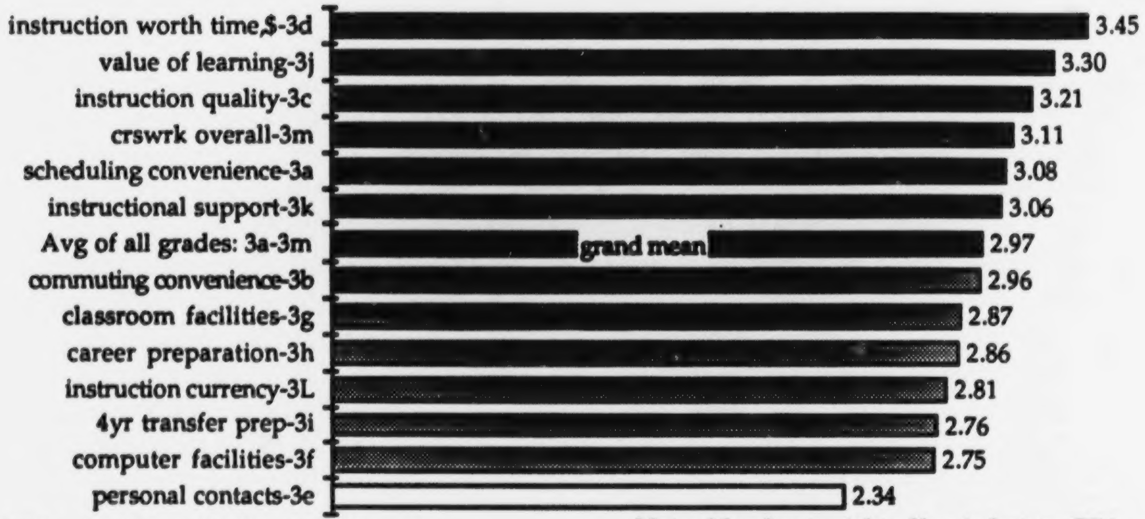
Completing the coursework for the associates degree was the primary reason given for most of the respondents for stopping coursework; 36 out of 53 selected the 'most important' response for this item. The other completion items were minor influences in comparison to degree completion.

Lack of time/life too busy headed the list of reasons for not completing coursework; this item was selected as most important by 9 of the 53 respondents. The other incomplete reasons averaged between no importance and minor importance.

Stopping coursework appears to be a poorly chosen construct, as it did not clearly address the issue of identifying successful and unsuccessful ex-students. There was so much cross-over in the responses to the complete and incomplete items that it was impossible to cleanly differentiate between successful and unsuccessful respondents. Future follow-up studies should focus more on cleanly separating respondents into categories based on success and satisfaction.

N=53

Chart 3: Coursework feature ranking by ex-students



Scale: 0 = "F" grade thru 4 = "A" grade

Note: Number to right of bar is feature GPA.

The respondents seemed reasonably satisfied with their coursework overall; both the average grade and the overall grade were "B".

The items on the quality, worth and value of instruction received the highest average marks (B+/A-). These high marks for instructional quality are a compliment to the instructional faculty and staff.

The items concerning personal contacts, transfer preparation, computer facilities and instructional currency received the lowest grades (C+/B-).

These relatively high grades should be tempered by the following observations:

1. Possible return bias. Most of the respondents returning the survey appear to be successful completors based on the findings from the 'stopping coursework' items; the complete items on Chart 2 received 55 'most important' responses while the incomplete items received 15 'most important' responses. This reasoning is not conclusive, but highly suggestive that satisfied ex-students returned the survey while unsatisfied students did not, thus favorably skewing the coursework evaluation.

2. The relatively low grades given to instructional currency and computer facilities are cause for concern; these features are crucial to the long-range health and competitiveness of the computer career programs.

3. The below average grade for career preparation is notable given the primacy of computer career motivation for starting coursework indicated in Chart 1.

Chart 4: Ex-student employment by computer system size

N=53

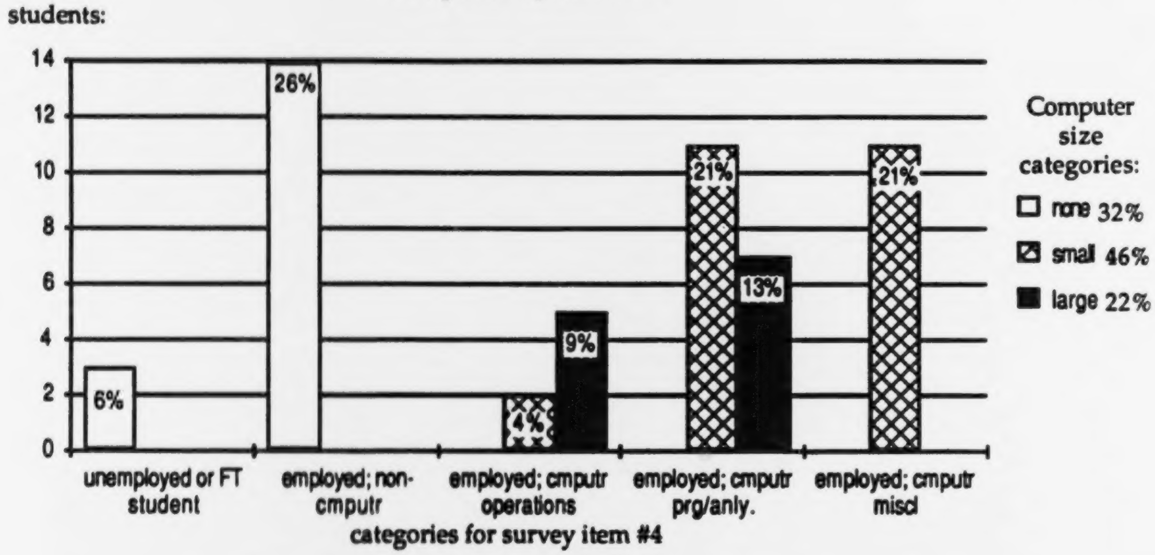


Chart 4 graphs the employment status of the respondents and for those employed in the computing field, shows both the size of the computer system of their employer and their computer employment specialty. The computer specialty categories are operations, programmer/analyst and miscellaneous; the miscellaneous category includes those whose duties were either a combination of operations and programming or were unclearly stated. The system size category of "large" denotes employment on a mainframe computer; "small" denotes non-mainframe employment; ie. mini or PC.

The following observations are indicated by chart 4:

1. 94% of the respondents are employed. Approximately two thirds of the respondents are employed in computing (68%).
2. Half of the computer-employed were working as programmer/analysts, the majority on small systems. This finding suggests that their is a continuing demand for programmer/analysts, which is the dominant training paradigm of the DPR program.
3. Over two-thirds of the computer-employed are working on either PC or mini based systems as opposed to mainframe systems. This finding is cause for concern given the mainframe base for most of the DPR courses.
4. Chart four strongly suggests a shift to a smaller system base for most courses given the indicated pattern of small system employment.

N=36 **Chart 5: Program assessment by computer-employed ex-students**

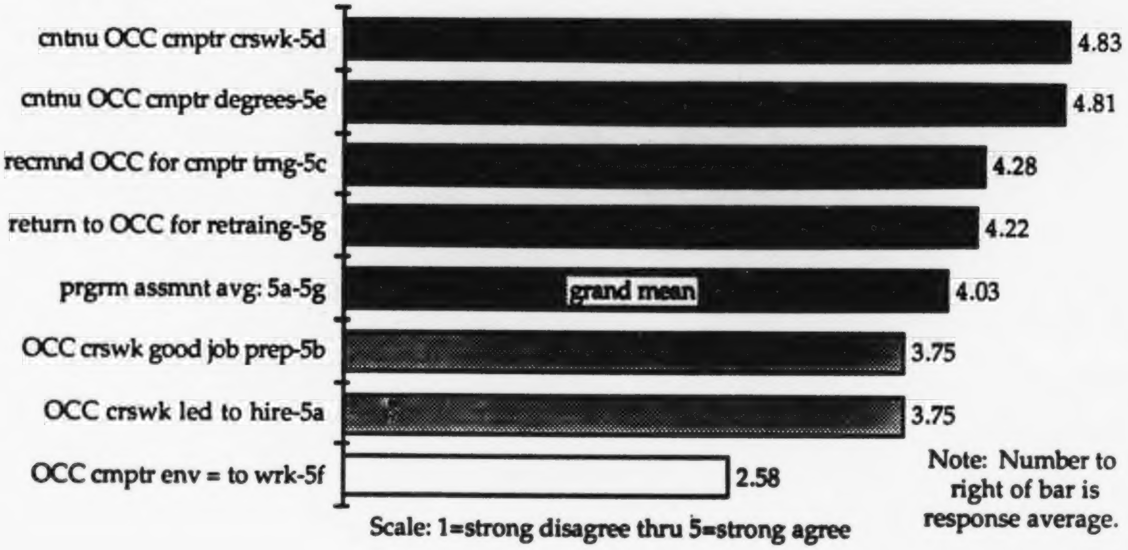


Chart five displays the response averages of computer-employed ex-students to a series of items attempting to measure their attitudes about their computer coursework at OCC. Chart five suggests the following observations:

1. The dominant attitude was highly favorable, as indicated by the strong agreement with statements suggesting continuation of computer courses and programs, and also by an overall average of four on a five-point response scale.

2. The relatively low rating given to a similarity of computer environments at OCC and work may be further evidence of the disparity between small system employment and mainframe training.

Chart 6A: Programming topic ranking by system size of computer-employed ex-students

N=36

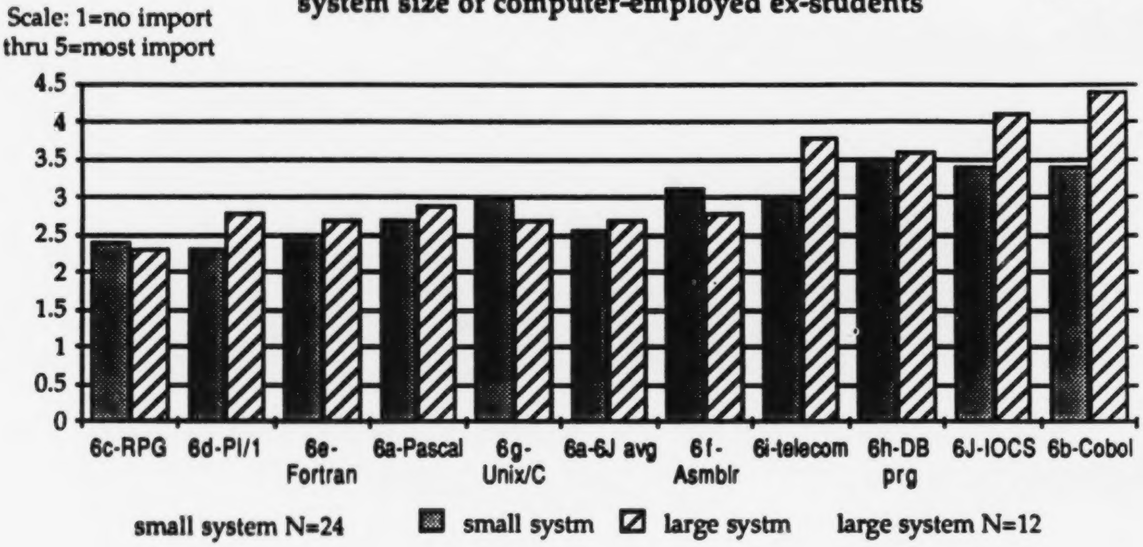


Chart 6A is the first in a series of three charts displaying attitudes of relative importance toward a series of computer coursework topics. In each chart, the response average of mainframe-employed students are contrasted with the response average from students employed on small systems. The focus of Chart 6A is the attiudes about the relative importance of computer programming topics. Note the following:

1. The overall average was mid-way between the second and third points on the scale, labelled "minor importance" and "some importance", respectively.
2. Cobol, IOCS and fourth-generation programming (database) were the topics given the highest ratings. The current DPR course offerings are strong in Cobol but weak in the other two areas.
3. Their were similar response patterns for the mainframe and small cohorts, with some slight discrepancies. The mainframe cohort rated Cobol, IOCS aand telecommunications the highest while the small system cohort gave the highest ranking to database, Cobol aand IOCS, respectively.
4. The small system cohort gave slightly higher rankings to Unix/C and Assembler, which suggests a desire for more understanding of computer system mechanics.

Chart 6B: Conceptual topic ranking (highest) by system size of computer-employed ex-students N=36

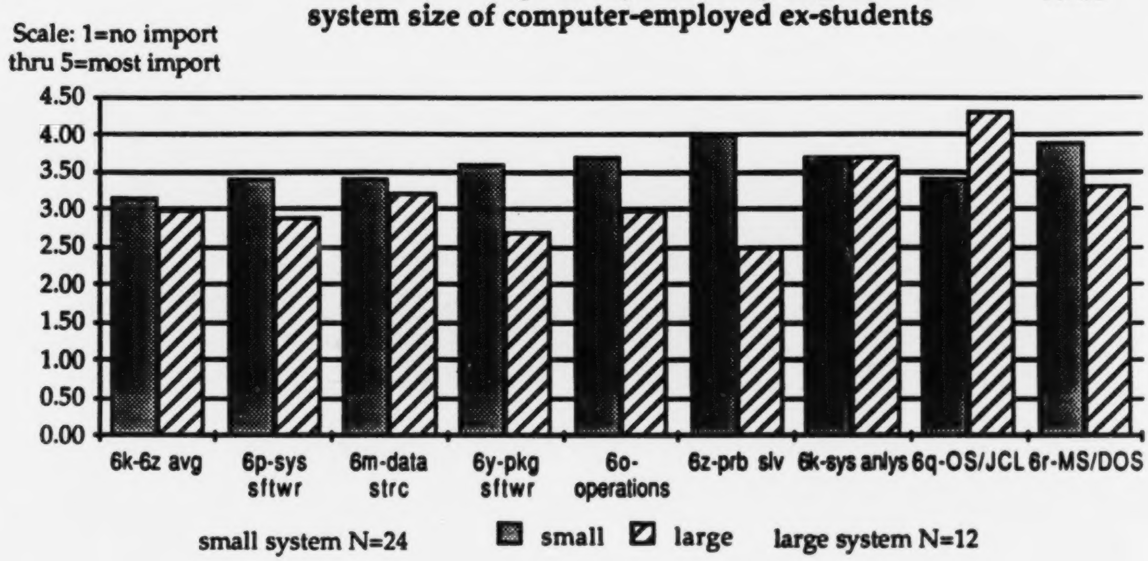


Chart 6B is the second in a series of three charts displaying attitudes of relative importance toward a series of computer coursework topics. In each chart, the response average of mainframe-employed students are contrasted with the response average from students employed on small systems. The focus of Chart 6B is the attiudes about the highest-ranked computing concept topics. Note the following:

1. The overall average was on the mid-point on the scale, which was labeled 'some importance'. The conceptual topic average was higher than the programming topic average (3.0 vs 2.5).

2. Knowledge of operating systems and system analysis basics were the topics ranked highest. The current DPR curriculum offers a solid course in system analysis basics, but is relatively weak in the area of operating systems.

3. The small system cohort ranked the conceptual topics slightly but consistently higher than the mainframe cohort. The differences were widest for the topics "problem solving", "package software" and "operations".

Chart 6C: Conceptual topic ranking (lowest) by system size of computer-employed ex-students

N=36

Scale: 1=no import
thru 5=most import

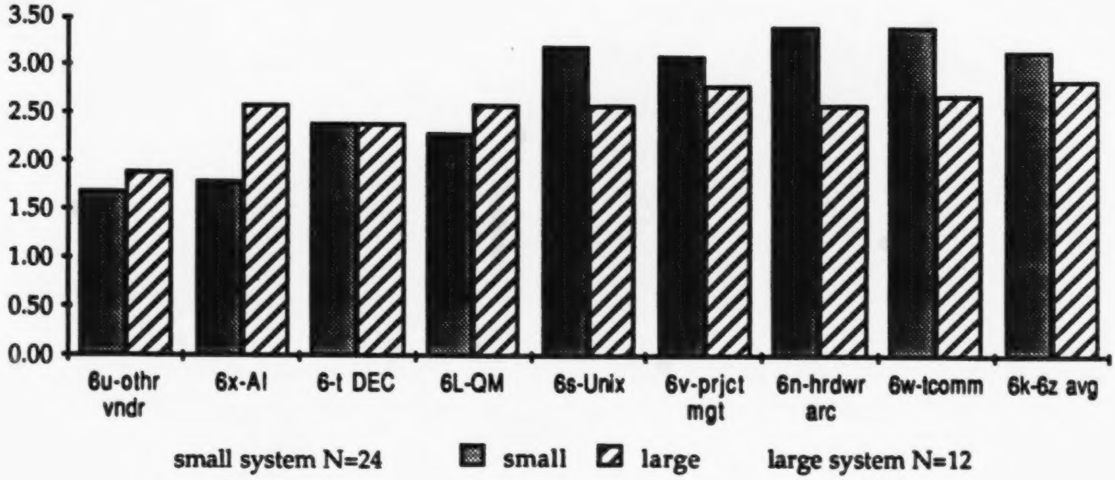


Chart 6C is the third in a series of three charts displaying attitudes of relative importance toward a series of computer coursework topics. In each chart, the response averages of mainframe-employed students are contrasted with the response averages from students employed on small systems. The focus of Chart 6C is the attiudes about the lowest-ranked computing concept topics. Note the following:

1. The topics related to non-IBM vendors, "artificial intelligence" and "quantitative methods" received the lowest rankings.

2. Chart 6C displays a continuation of the pattern from Chart 6B; higher rankings for the conceptual topics by the small system cohort.

In summary, Charts 6A thru 6C suggest that:

1. The topic importance rankings differed by the system size of computer employment.

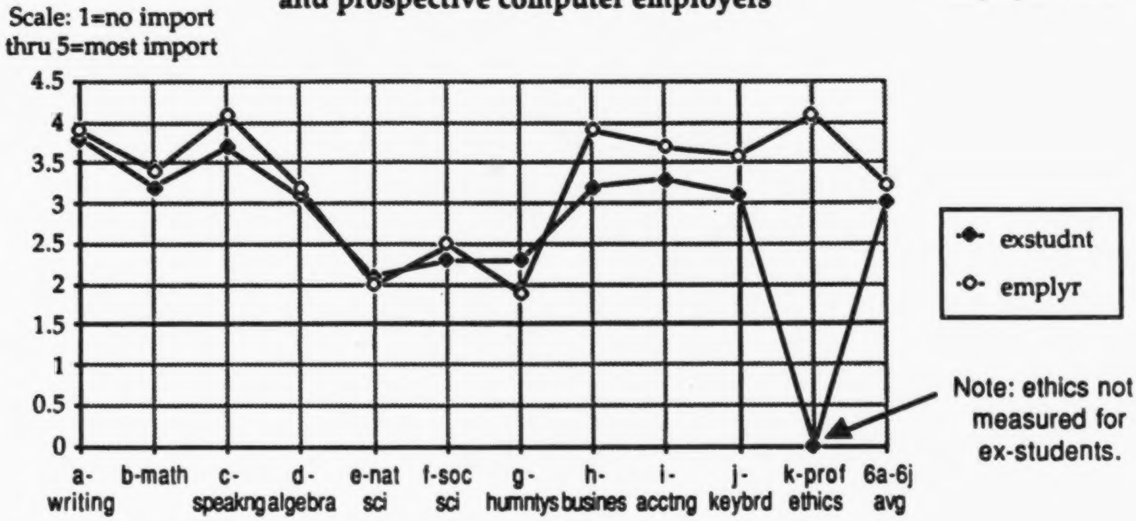
2. The small system cohort rated conceptual topics relatively higher than programming language topics; their choices suggested a desire for a program with a broad range of conceptual computing topics, an emphasis on fouth generation programming languages coupled with machine level programming languages and except for Cobol, less emphasis on procedural programming languages.

3. The mainframe cohort also ranked the conceptual topics higher on average than programming topics, but to a lesser degree than the small system cohort. The mainframe choices suggest a desire for a program with a strong emphasis on system mechanics (IOCS, OS/JCL and telecommunications programming) coupled with Cobol, fourth generation programming and system analysis basics.

4. Accomodation to these preferences entails major revisions in the DPR curriculum, most notably in the areas of system mechanics, communications and fourth generation programming.

Chart 7: Comparison of support course rankings by computer-employed ex-students and prospective computer employers

ex-student N=36
employer N=51



Note: ethics not measured for ex-students.

Chart 7 marks the transistion between the survey results for ex-students and the survey results for prosective computer employers. Chart 7 contrasts the importance rankings of ex-students and prospective employers for support course topics. Note the following:

1. The ranking patterns for ex-students and employers were very similar; this indicates substantial agreement on the relative importance of support coursework between these two groups.

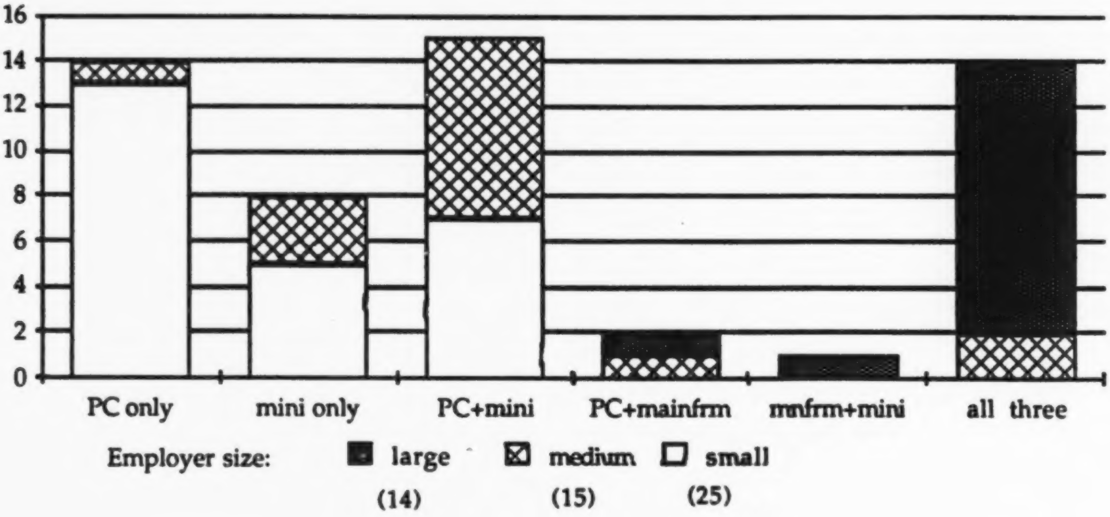
2. The average rating was on the midpoint of the scale; "some importance". This midpoint average was similar to the average importance rating given to computing topics by ex-students, suggesting that ex-students view support coursework and computing coursework as equally important.

3. Communications, business-related topics, math and keyboarding were given the highest rankings. "Professional ethics" was ranked highly by employers, but was not measured for ex-students.

4. Humanities and sciences were ranked the lowest. This is to be expected given the indirect relevance of these topics to computer employment.

Chart 8: Hardware configuration distribution by prospective computer employer size

N=54



The remaining series of charts displays the results from the survey of prospective computer specialist employers. Charts 8-12 display characteristics of the employer's computer system platforms, charts 13-16 denote the employer's application software characteristics and charts 17-18 show the employer's current and projected computer specialist employee counts.

Chart 8 shows the hardware configuration of the employer sample contrasted by the size of the employer. Employer size was determined by the number of computer specialist employees reported; small = 1-3, medium = 4-29, large = 30+. The "PC" category includes both stand-alone PC's and PC LAN's. The "mini" category includes super-micro timeshare systems, departmental computers and small mainframe systems. The "mainframe" category denotes large mainframe systems. Note the following:

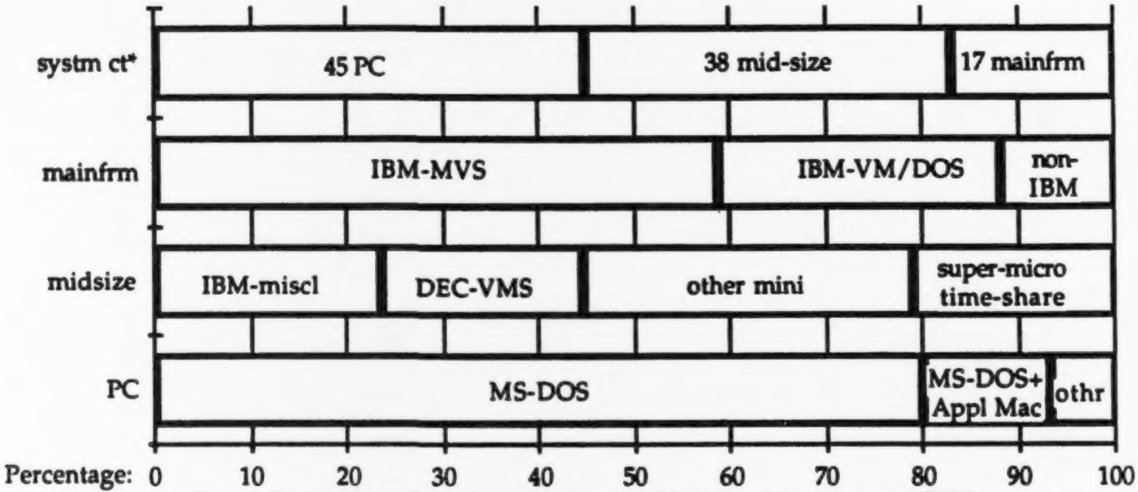
1. The chart displays a preponderance of mixed configurations, particularly on the larger end of both the employer and system size scales. This implies that a knowledge of PC and mini systems is important regardless of the size of the employer.

2. Mixed configurations also indirectly underscores the importance of communications in order to understand the linkages between systems, reinforcing the finding from chart 6A; students employed in mainframe environments gave a high ranking to telecommunication programming.

3. The current DPR/OIS curriculum addresses the needs of stand-alone mainframes and PC's; midsize systems and mixed configurations are ignored.

N=54
employers

Chart 9: Operating system distribution by system size for prospective computer employers



* systm ct refers to the number of employers reporting this type of system; not a CPU count.

Chart 9 displays the sytem software environments reported by computer system size. The top bar displays the number of employers reporting the indicated system size types and should not be mis-construed as a computer count. Note the following:

1. The mainframe environment is dominated by IBM-MVS; the OCC mainframe computer was recently upgraded to MVS.
2. Employers reported a wide variety of midrange environments; small super-micro timeshare systems such as Altos; IBM system/3x systems; IBM 4300/VM/DOS systems; DEC/VMS etc. Perhaps Unix will emerge as the standard in this size range.
3. The small, personal systems are currently dominated by MS-DOS with some penetration by the Apple Macintosh. The current MS-DOS dominance is currently being challenged not only by Apple/Mac, but also by the emergence of OS/2 and possibly Unix as well.
4. The OCC computer programs are currently geared to the VM/CMS/VS1 environment for the mainframe and MS-DOS for PC's; there is one course in Unix.

Chart 10: Communication level distribution by hardware configuration for prospective computer employers

N=54

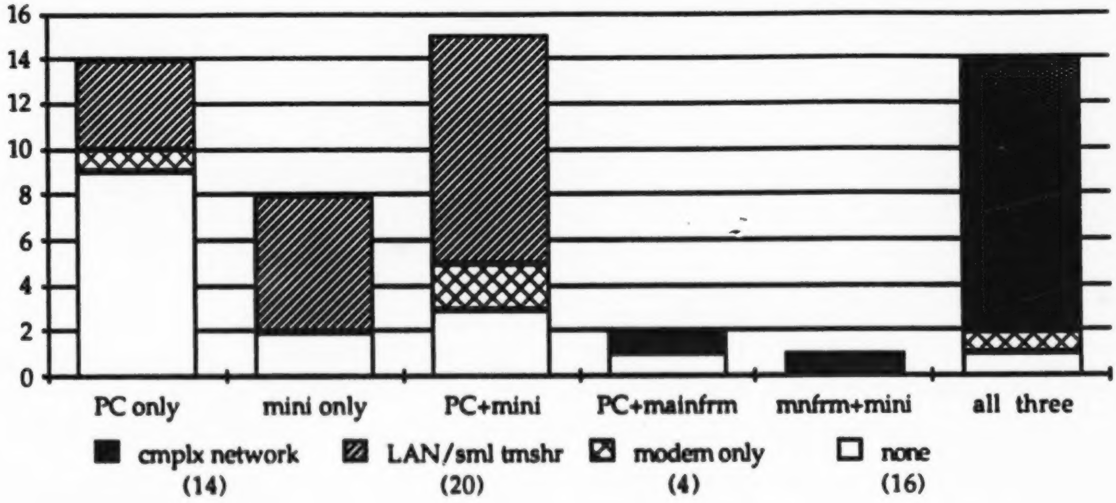


Chart 10 displays the level of communication technology within the reported hardware configurations of the sample. "modem only" indicates a simple leased or dial-up line configuration. "LAN/small timeshare" denotes a small or local network configuration with some sharing of data and resources. "complex network" indicates a large, sophisticated network with many levels and stations. Note:

1. The preponderance of networked communications throughout the system size range,

2. The communication complexity of the large mainframe configurations.

3. The importance of communications regardless of system level.

4. Communications training is non-existent in the current DPR/OIS programs.

Chart 11: Communication software distribution by prospective computer employer size

N=28 employers

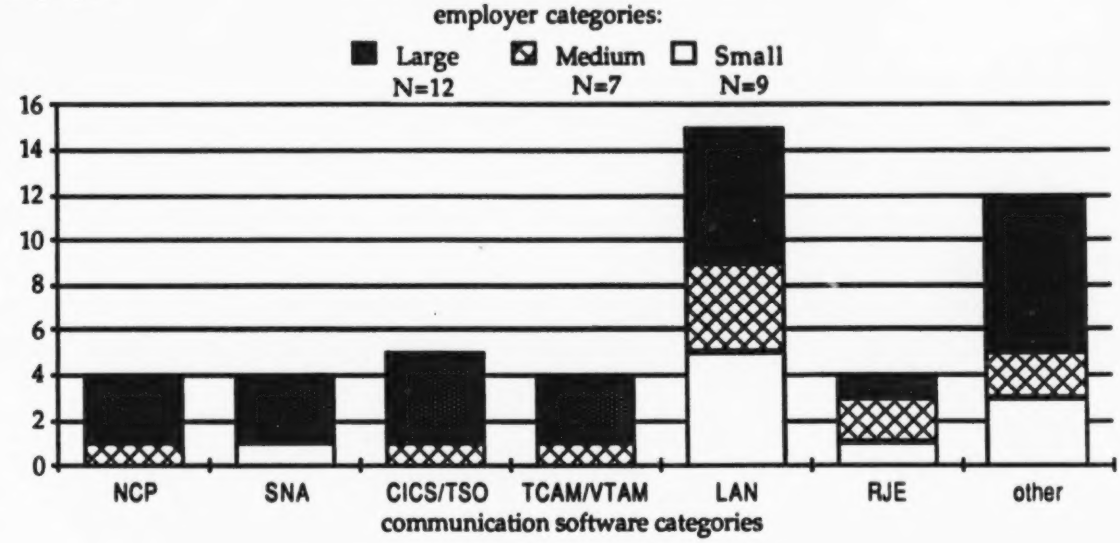


Chart 11 displays the communications system software characteristics of the employer's computer systems. The left-most four categories denote IBM products; "NCP" = network control protocol, "SNA" = system network architecture, "CICS/TSO" = communication interface control system/timeshare system operation and "TCAM/VTAM" = telecommunication access method/virtual telecommunication access method. "LAN" refers to local area network, "RJE" to remote job entry and "other" to unspecified communication software. Note the following:

1. These findings are from half of the employer sample and are under-reported for the small and mid-range systems.

2. The wide variety of IBM communication offerings in the mainframe environment.

3. The importance of local area networks throughout the system size range.

4. The current OIS/DPR programs offer nothing in this area.

Chart 12: Computer repair practices by prospective computer employer size

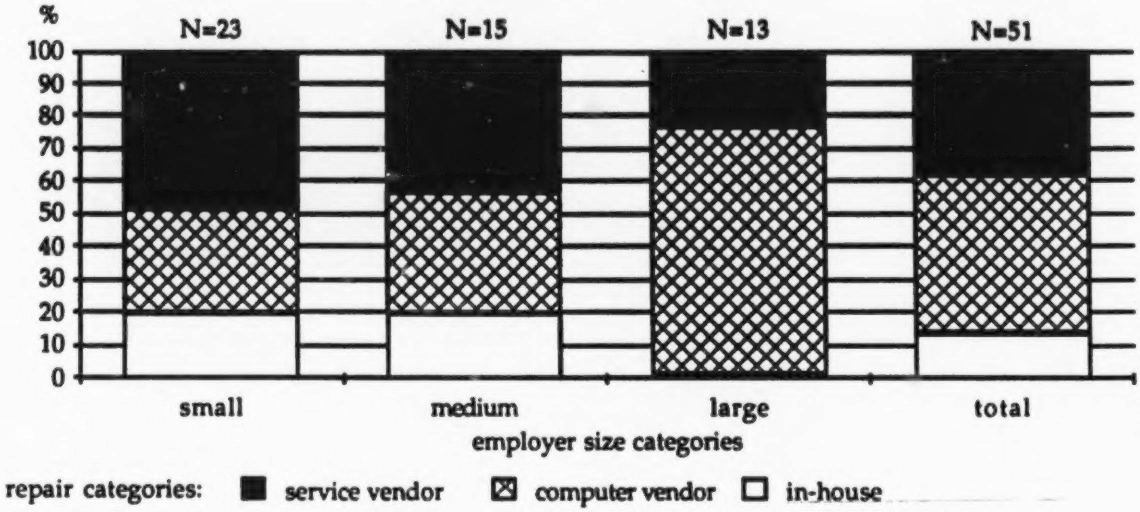


Chart 12 is the last in the series of charts displaying the computer system platform characteristics of prospective employers and shows computer repair practices by employer size. "service vendor" refers to repair by contract or on-call from a repair service company, "computer vendor" refers to repair by the company selling the computer equipment and "in-house" refers to repair by a service function within the employer's organization. Note the following:

1. Repair practice appears to be a function of system size.

2. Repair practice shifts from vendors on mainframes to service companies on small computers.

3. In-house repair has a minor role for small and midsize systems.

4. OCC has a new program in computer repair on the Auburn Hills campus focusing on small computer equipment.

Chart 13: Application software source estimates for prospective computer employers by employer size

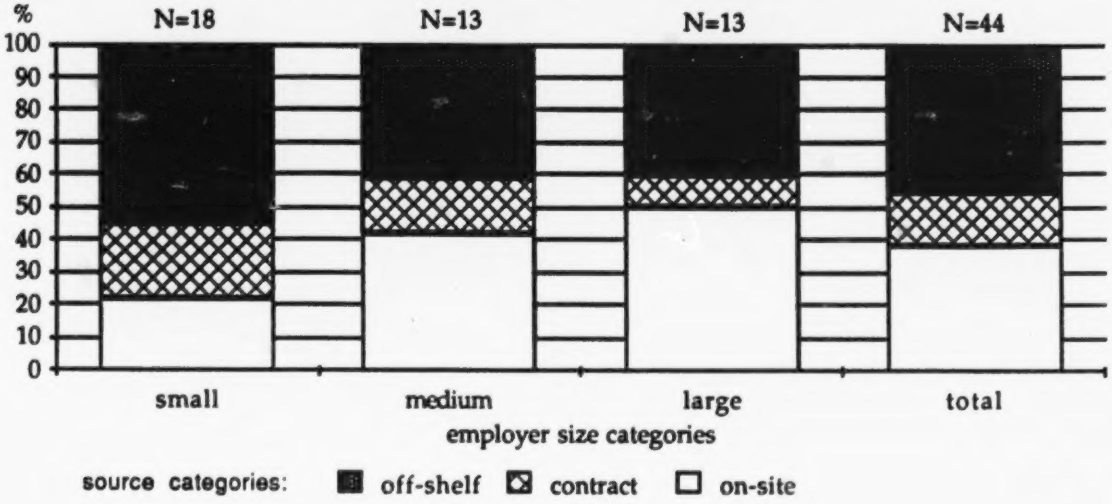


Chart 13 is the first in a series of four charts displaying the characteristics of the prospective employer's application software practices. Chart 13 displays the sources for application software by employer size. Note the following:

1. Application source is apparently a function of employer size.
2. On-site development increases in proportion to size while off-shelf purchase and contract programming increase as employer size decreases.
3. Overall, almost half of the application software was purchased off-shelf while less than forty percent was developed in-house.
4. The major emphasis of the current DPR program is development of application software for mainframes, which is still the dominant source for mainframes. However, the trade literature suggests that off-shelf or package software will continue to replace site-developed software and the current program does not address the use of off-shelf or package software on mainframes.
5. Both the small computer DPR option and the OIS program address the usage of off-shelf or package software for small computers. Neither program addresses midsize systems.

Chart14: Application development language distribution by prospective computer employer size

N=44
employers:
small=18
medium=13
large=13

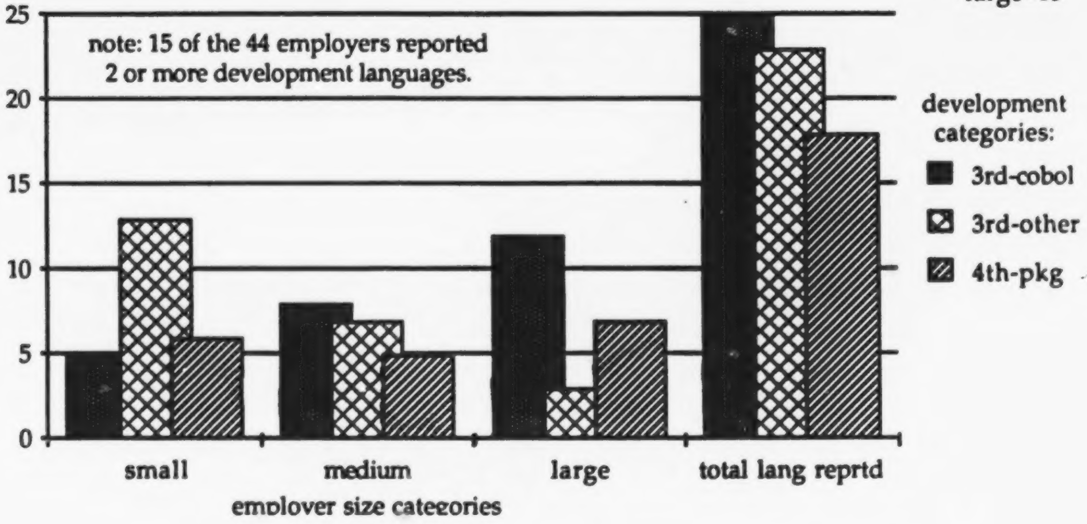


Chart 14 displays the languages used for application software development contrasted by employer size. "3rd-cobol" refers to the use of the third generation procedural language of Cobol, "3rd-other" refers to the use of another procedural language, such as Basic, Pascal, PL/1, Fortran etc., and "4th-pkg" refers to the use of fourth-generation application generators such as Focus, Oracle, Dbase etc. A third of the employers reported more than one of these three, ie. Cobol and another procedural language or a procedural language in combination with an application generator. Note the following:

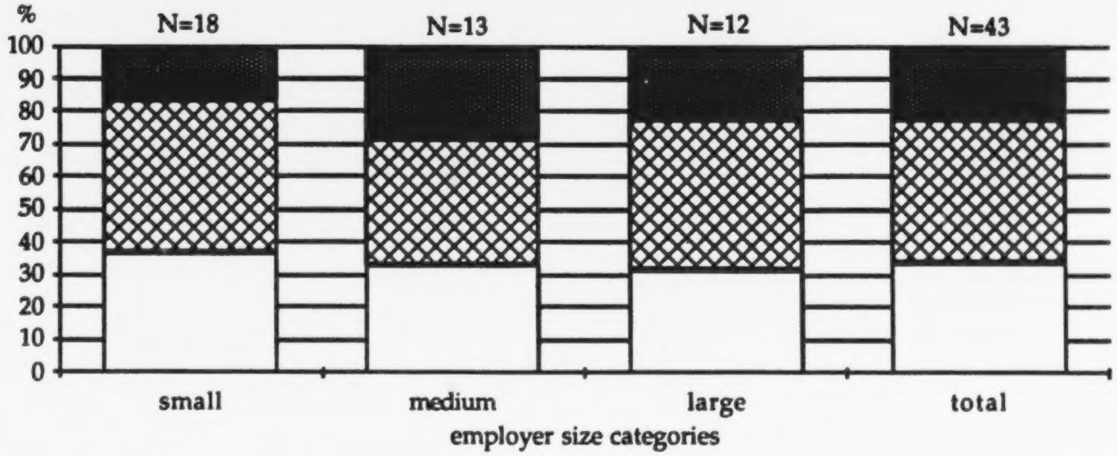
1. Cobol usage increases in proportion to employer size.

2. Other procedural languages increase in inverse proportion to employer size.

3. Application generators show constant proportion throughout the size range. The trade literature suggests that this segment will increase at the expense of the traditional procedural languages.

4. The current DPR program is strong in the area of traditional procedural language application development, weak in the use of application generators on small systems and ignores application generators on midrange and large systems.

Chart 15: Estimated level of end-user computer interaction within prospective computer employers by employer size



end-user categories: ■ power end-use ☒ basic end-use ☐ batch reports

---

Chart 15 displays estimates of computer end-user practices within prospective employer organizations contrasted by employer size. "batch reports" denotes the traditional role of end-user detatchment from direct computer usage and reliance on computer-generated reports; "basic end-use" denotes the use of a terminal or PC with limited computer literacy; ie. usage of word-processing packages, low-level usage of spreadsheets and data bases etc.; "power end use" denotes the use of a terminal or PC with a high level of computer literacy; ie. high-end use of spreadsheets and data bases, application generation, quantitative analysis etc. Note the following:

1. End-user excludes computer specialist employees.

2. Two-thirds of the end-users are reported to be directly using the computer.

3. The direct use proportion is constant throughout the employer size range.

4. OCC has courses in place in both the OIS and DPR programs to address the computer literacy needs of end-users.

Chart 16: Application package software distribution by prospective computer employer size

N=50
employers

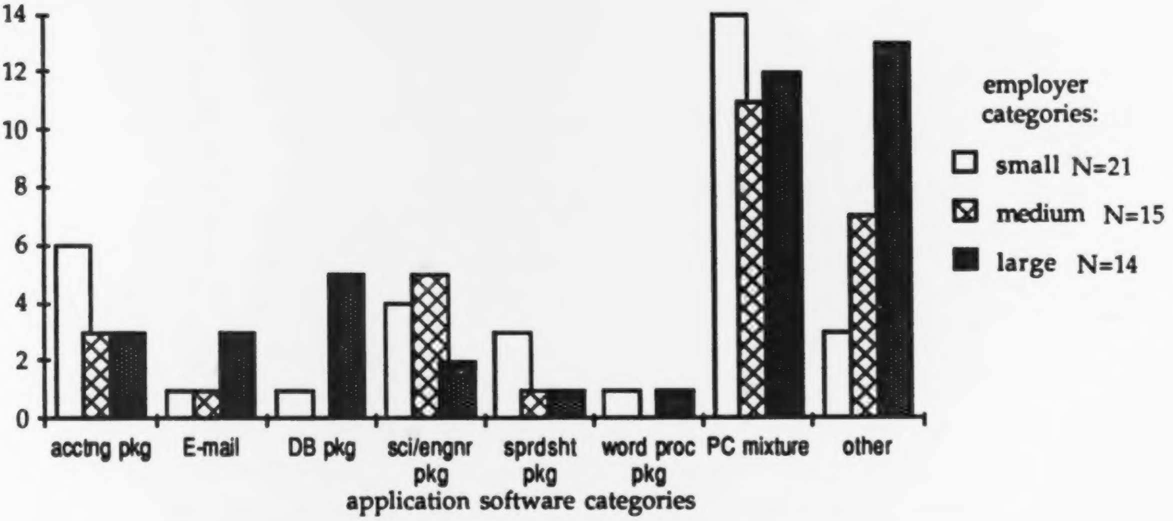
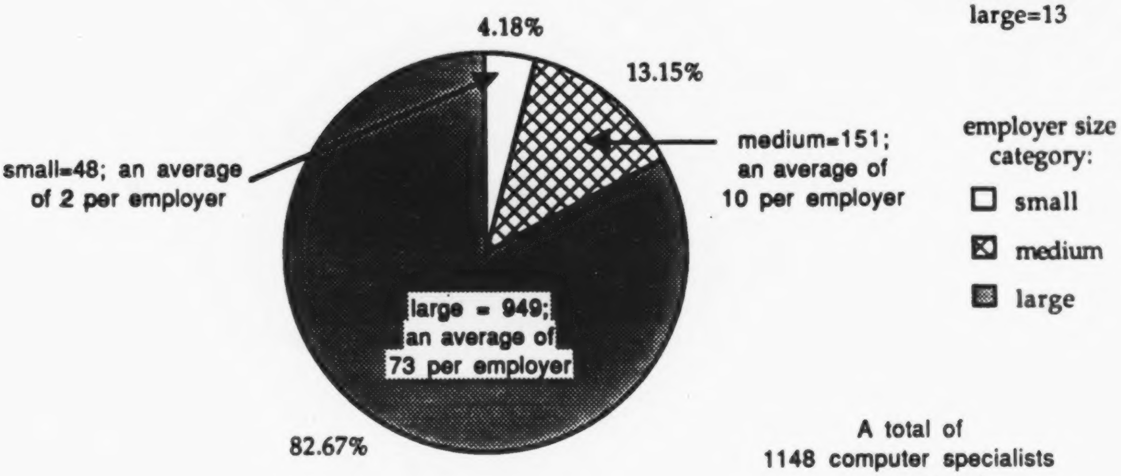


Chart 16 is the last in the series of charts displaying the application software practices of prospective employers and shows the pattern of package usage by employer size. "acctng pkg" = accounting package; "E-mail"=electronic mail; "DB pkg"=data base package; "sci/engnr pkg"= scientific or engineering-related package software; "sprdsht pkg"= spreadsheet software; "'word proc pkg"=word processing software; "PC mixture"=popular mix of PC software; ie. word processing, data base and spreadsheet; "other"=other application software packages such as payroll, inventory, markert analysis etc. Note the following:

1. The categories "DB pkg", "sprdsht pkg" and "word proc pkg" differ from "PC mixture"in that the repondent mentioned the former packages specifically without mentioning the others.
2. Word processing, spreadsheets and data base packages are found throughout the employer size range.
3. Accounting packages were the most frequently mentioned application-specific software.
4. Word processing and spreadsheet software usage is addressed at both the basic and advanced levels by the DPR/OIS programs. Advanced data base usage is not adequately addressed.

Chart 17: Computer specialist employees by prospective computer employer size

N=52 employers:
small=24
medium=15
large=13

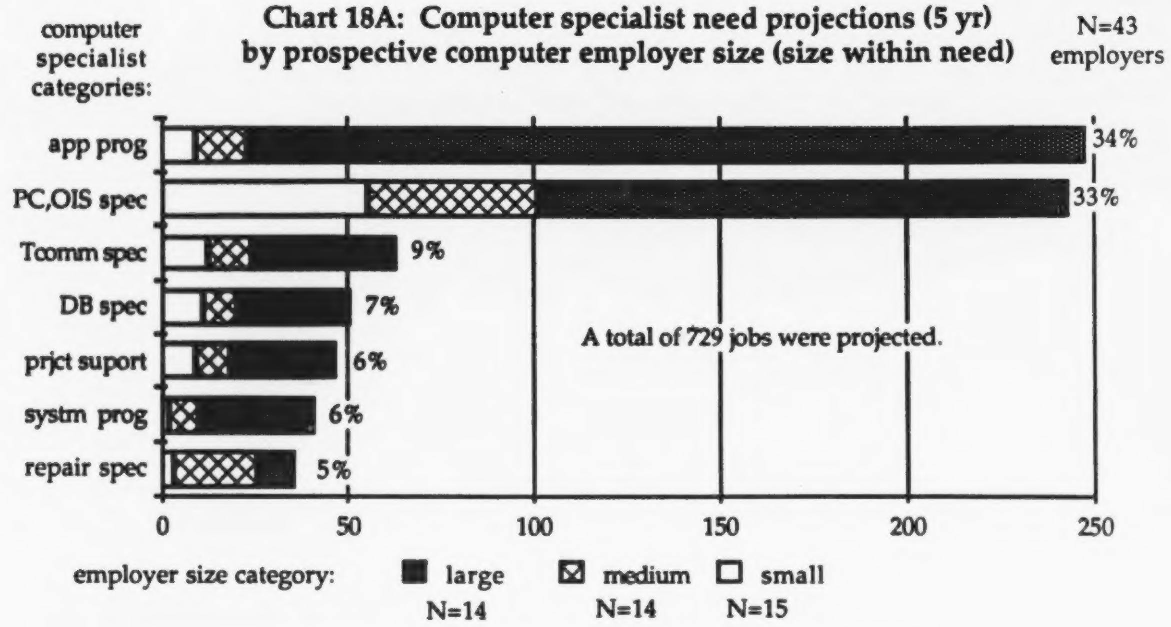


A total of
1148 computer specialists
were reported.

Chart 17 displays the number of computer specialists reported for the prospective employers by employer size. It was difficult to distinguish with sufficient accuracy the types of computer specialists due to both non-reporting of detail and also title ambiguity for the categories of small and medium size employers. This item needs to be revised in future surveys in order to remedy these problems.

The counts were dominated by the large employers. Although fewest in number, they employed an average of 79 specialists each as opposed to 10 and two for the medium and small employers, respectively.

Chart 18A: Computer specialist need projections (5 yr) by prospective computer employer size (size within need)



The last two charts of the survey findings display the five year projections for computer specialist employees as reported by the prospective employers. Chart 18A shows these projections by employer size within specialist category. "app prog"=application programmer; "PC/OIS spec"=small computer/office information specialist; "Tcomm spec"=telecommunication specialist; "DB spec"=data base specialist; "prjct suport"=project support specialist; "systm prog"=system programmer; "repair spec"=repair specialist. Note the following:

1. Application programmer and PC/OIS specialist were the categories with the largest projected need, each accounting for a third of the projected total.

2. Most of the application programmer demand was from large system employers; the PC/OIS demand was more evenly distributed by size.

3. The remaining third of the the projected specialist need averaged about 50 jobs each, led by telecommunication specialist and data base specialist.

4. The DPR/OIS programs are targeted towards large-system application programmers and PC/OIS specialists, the two categories with the largest projected demand. OCC has also recently started a program in computer equipment repair.

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Chart 18B: Computer specialist need projections (5 yr) by prospective computer employer size (need within size)

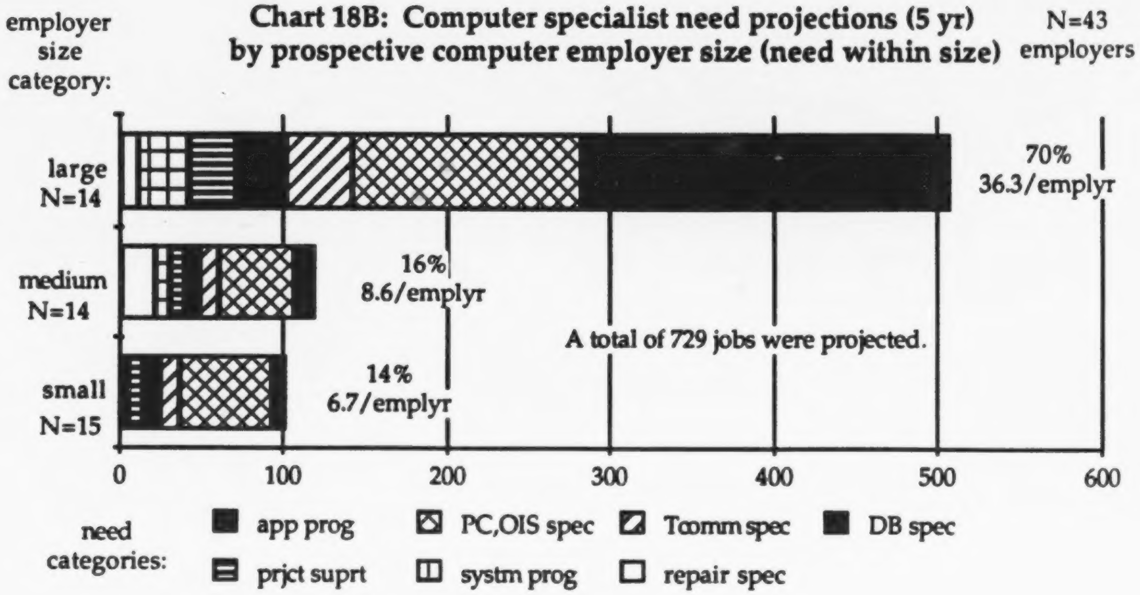

Chart 18B displays the computer specialist need projections by specialist category within employer system size. The specialist category abbreviations are the same as those used in chart 18A. Note:

1. Most of the projected jobs were from employer's with large systems, but with a lower percentage of the total than for current computer specialists (see chart 17).
2. Large system demands are primarily for application programmer and PC/OIS specialist, followed by specialists for telecommunications, data base, project support and system programmer.
3. Medium system demand is led by PC/OIS specialist, followed by specialists for equipment repair, telecommunications and application programmer.
4. Small system demand is led by PC/OIS specialist followed by specialists for telecommunications and data base.
5. The DPR/OIS programs at OCC are focused on the primary needs of small and large system employers for application programmers and PC/OIS specialists. More specialized needs and the medium sector are ignored, with the exception of the new computer equipment repair program.

Summary of Survey Findings

DPR ex-students

1. A desire for a a career in computing was the primary reason for starting coursework (chart 1).
2. Aside from receiving a degree, lack of time or being too busy was the primary reason given for stopping coursework (chart 2).
3. The students rated their computer coursework favorably, especially instruction (chart 3).
4. Two thirds of the students were employed as computer specialists, a sizeable majority of them in small system environments (chart 4).
5. Those employed as computer specialists rated their coursework favorably as job preparation with the exception of similarity of training and job computer environments (chart 5).
6. Those students employed on mainframe systems rated Cobol and OS/JCL as the most important coursework topics. Students employed on small systems rated Dbase, MS-DOS and problem solving as most important (chart 6).
7. Students rated support coursework at the same level of importance as employers. Written and verbal communication, math and business were rated highest (chart 7)

Prospective employers

1. Employer hardware platforms were characterised as a mix of different size systems (chart 8).
2. MVS was the dominant system software for large systems and MS-DOS for small systems; there was no clear pattern for midsize systems (chart 9).
3. Some type of computer communications technology was found on 70% of the reported systems. Local area networks were the most prevalent (charts 10 and 11).
4. The source for application software was off-shelf for small systems and in-house for mainframes (chart 13).
5. For in-house development, Cobol was the language of choice for large systems and a variety of procedural languages for small systems. Application generators were an important factor for all size systems (chart 14).
6. The majority of end-users were using a terminal or PC in some capacity. The use of a popular mix of PC software including word processing, spreadsheet and data base packages was mentioned most often (charts 15 and 16).
7. For this sample, computer specialists were employed primarily on large systems (chart 17).
8. Application programmers on large systems and PC/OIS specialists on smaller systems were the job categories with the highest need projections (chart 18).

Recommendations

1. The existing DPR/OIS programs be updated to focus on linked, multi-level systems.

2. That the system environment basis for DPR/OIS course offerings be shfted from stand-alone mainframe and PC systems to linked, three-level systems; PC, midsize and mainframe. The surveys revealed the midrange system as an important factor ignored completely by current OCC programs.

3. Coursework in application generation from data base packages be added.

4. Coursework in the CASE methodology (Computer Application Software Engineering) be added.

5. Coursework in the use and programming of computer communications technologies be added.

6. Coursework on operating system concepts, use and programming be added.

7. That the current text command-line user interface be replaced by a graphics-oriented window environment.

8. That room be made for DPR additions be at the expense of current mainframe languages other than Cobol; ie. PL/1, Fortran and Assembler.

9. That the DPR prefix be changed to CIS (Computer Information Science) as courses are added and modified.

10. That the current program framework of OIS and mainframe/small system DPR offerings be kept intact. This program framework matches the pattern of job projection needs from the employer survey. What is needed is the addition of new courses, updating of existing courses and installation of a modern computer system base to revitalize these programs.

OAKLAND COMMUNITY COLLEGE
COMPUTER CURRICULUM IMPROVEMENT PROJECT: FORMER STUDENT OPINION

We need your opinions to help us improve our computer course offerings. As part of a continuing effort to improve our computer curriculum, Oakland Community College requests your thoughtful response to the following items addressing your opinions about the computing curriculum and how it could be improved. **Thank you** from Dr. Henry Austin, project coordrinator.

Why did you start taking computer courses at OCC and why did you stop? First read through the list of reasons below which might have influenced your decisions in these regards and then rate each reason based on that reason's influence on your decision. Place the scale number in the space next to each reason.

Your Name: ____________________

Daytime phone: ____________________

1	2	3	4	5
no importance	minor importance	some importance	very important	most important

1) **Reasons for starting computer coursework at OCC:**

___ a) OCC catalog or promotional literature.
___ b) Recommendation from high school counselor.
___ c) Recommendation from OCC counselor.
___ d) Recommendation from family/friend/co-worker.
___ e) OCC advertisement.
___ f) OCC's reputation.
___ g) Reputation of OCC's computer courses.
___ h) Desire to prepare for a computer-related career.
___ i) Low tuition and fees relative to computer courses at other schools.
___ j) Tuition reimbursement or other incentives from your employer.
___ k) Student services; ie day care, woman's center, etc.
___ l) Course scheduling times were convenient.
___ m) Course locations were convenient for commuting.
___ n) Desire for college credits.
___ o) Personal decision to learn about computers.
___ p) Other ____

2) **Reasons for stopping computer coursework at OCC:**

___ a) Completed the requirements for an Associates degree.
___ b) Completed the requirements for initial computing employment.
___ c) Completed the requirements for transfer to a four year institution.
___ d) Completed the courses needed for continuing education, retraining etc.
___ e) The rest of my life became too busy; no time for coursework.
___ f) Change in career goals.
___ g) Poor instruction.
___ h) The coursework was too demanding.
___ i) Financial pressures.
___ j) Personal reasons.
___ k) Poor computer facilities.
___ l) Course scheduling times were inconvenient.
___ m) Course scheduling locations were inconvenient for commuting.
___ n) Other ____

Please use the back of this form to make any additional comments about your reasons for starting and/or stopping computer coursework at OCC.

3) Please **GRADE your computer courses as a group** on the following items; write your grade in the space to the left of each item (**A B C D F**).

___ a) Convenience of course scheduling times.
___ b) Convenience of course scheduling locations for commuting.
___ c) Quality of instruction.
___ d) Instruction worth the costs of your time and tuition investment.
___ e) Personal contacts (study groups, social, business etc.)
___ f) Computer facilities.
___ g) Classroom facilities.
___ h) Career preparation.
___ i) Transfer preparation.
___ j) Value of what you learned.
___ k) Instructional support (answers to questions, computer help etc.).
___ l) Currency of instruction; up-to-date? state-of-the-art?
___ m) Overall general grade for computer courses as a group.
___ n) Other____

4) **Current job tile and brief duties description:**

5) **If your current job is involved with computers**, use the scale provided to respond to the items below; **If not, proceed to item 7**.

1	2	3	4	5
strongly disagree	disagree	neutral	agree	strongly agree

___ a) My computer coursework at OCC was one of the major reasons I was hired.
___ b) My computer coursework at OCC prepared me well for my job.
___ c) I would recommend OCC to someone who wanted computer training.
___ d) OCC should continue to offer coursework in computing.
___ e) OCC should continue to offer degrees and certificates in computing.
___ f) The computer environment at work is similar to the one at OCC.
___ g) I would return to OCC for retraining in computing if the needed courses were offered there.

h) **Briefly describe the computer environment you use at work**; ie processor(s), system software, application packages, application development tools, workstations etc.

Use the back of this page for any additional comments about your computer coursework at OCC and/or it's relationship to your current job.

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6) **If you are currently employed in a computer-related position, rank the following topics** in terms of their importance to the education of computing professionals:

1	2	3	4	5
no importance	minor importance	some importance	very important	most important

Topics for the computing curriculum:

___ a) Programming basics-Pascal
___ b) Programming-COBOL
___ c) Programming-RPG
___ d) Programming-PL / 1
___ e) Programming-Fortran
___ f) Programming-Assembler
___ g) Programming-UNIX / C
___ h) Programming-Database;
DL, Oracle, Focus, SQL, Dbase etc.
___ i) Programming-Telecommunications;
CICS, VTAM, etc.
___ j) Programming-Access methods;
relative, direct, indexed (VSAM)
___ k) System Analysis basics
___ l) Quantitative methods basics;
CPM, simulation, linear programming
___ m) Data structure concepts; stacks,
linked lists, trees etc.

___ n) Hardware architecture
___ o) Computer system operations
___ p) System software architecture
___ q) IBM OS concepts (including JCL)
___ r) MS-DOS concepts
___ s) UNIX concepts
___ t) DEC/VAX concepts
___ u) Other vendor ______________
___ v) Project management concepts
___ w) Communication system concepts;
LAN, distributed networks etc.
___ x) Expert system concepts; AI etc.
___ y) Workstation software; word
processing, spreadsheets etc.
___ z) Problem solving techniques & tools
Other topics: ____________________
____
____

Additional suggestions for computer course topics, programs, etc.

Basic skills and core requirements; ie. support coursework

___ a) Written communication (English composition).
___ b) Discrete math (# systems, sets)
___ c) Verbal communication (speech)
___ d) Algebra
___ e) Natural science courses
___ f) Social science courses

___ g) Humanities courses
___ h) Business basics
___ i) Accounting basics
___ j) Keyboarding skills
Other coursework:
____
____

Use the back of this page for additional comments or suggestions on computer course topics and / or support course topics.

7) Please **list the things about the OCC computing program that you liked the most;** in other words, those things about the OCC computing program that should **not be changed**.

8) Your **POSITIVE** suggestions for changes in the OCC computer program which would be of most benefit for future students in the program:

Thank you for your thoughtful responses. Please **return the survey** in the envelope provided or to:

Dr. Henry Austin F115
OCC - Orchard Ridge Campus
27055 Orchard Lake Rd.
Farmington Hills, Mi. 48018

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OCC
OAKLAND COMMUNITY COLLEGE
ORCHARD RIDGE CAMPUS • 27055 ORCHARD LAKE RD • FARMINGTON HILLS, MICHIGAN 48018 • 313-471-7500

COMPUTER CURRICULUM IMPROVEMENT PROJECT
OPINION SURVEY OF COMPUTER SPECIALIST EMPLOYERS

Dear Manager,

We need your help in order to continue preparing well-educated computer specialists for Oakland county employers. **Please enlist the cooperation of the computer expert** in your organization who advises you or your personnel office **on computer-related employee selection and training** to fill out and return the enclosed survey. The survey assumes a knowledge of both computer technology and the computer expertise needs of your organization; it should take about **fifteen minutes** to complete.

The advice we receive from employer surveys is an invaluable source of information for helping us design computer education programs that are relevant to the needs of both our students and their employers.

Please do not hesitate to call me at **471-7726** if I can be of any assistance.

Thank You,

Dr. Henry Austin

Dr. Henry Austin,
Project Coordinator

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OAKLAND COMMUNITY COLLEGE
COMPUTER CURRICULUM IMPROVEMENT PROJECT
OPINION SURVEY OF COMPUTER SPECIALIST EMPLOYERS

NAME ______________________________ **PHONE** ______________

POSITION ______________________________________

ORGANIZATION ______________________________________

1) Briefly **describe the computer systems** used at your site by filling in the information grid below:

(# = quantity)	**System Hardware**	**System Software**	**Most Important Application Software Packages**
Mainframe # ____			
Midsize # ____ (mini-computers, Dept. computers)			
Desktop # ____ (PCs, micros, workstations)			

2) **Briefly describe** your **computer communication environment:**

Hardware:

Software:

Configuration:

(OVER)

3) Briefly describe your computer **application program development environment**:

a) Where do your programs come from? (% estimate): In-house ____ Contract ____ Off-shelf ____

b) Predominant source **languages** (*i.e.* COBOL, RPG, FOCUS, DBASE *etc.*):

c) Number of **employees** by in-house computer-specialist **job category**

System programmers _____ Application programmers _____ System analysts _____

Programmer / analysts _____ Operations ______ Supervisory _____

Data entry ____ Others: ____

4) Give **percentage estimates** for the ways in which the following category groupings of **end-user personnel** in your organization **use computer information as a group** (*each category group should total 100*). **Do not include computer specialists** in your estimates.

Category Group	Use of batch reports	Basic interaction with PC or terminal	Sophisticated interaction with PC or terminal
Managers			
Adm. Asst., Secretarial			
Word Processing / Clerk			
Professional			
Other: ____________			

5) Give **percentage estimates** for the sources of your organization's **computer equipment maintenance and repair work:**

In-house ___ Computer vendor contract ___ Service vendor contract ___ Call-as-needed ___
Comment:

6) Assuming current economic conditions, **estimate** your organization's **most critical computer-related entry-level hiring and retraining needs** over the next five years by job category:

Job Category	Entry-level new hires	Retraining candidates

7) Below are brief descriptions of the **existing computer-related programs** offered by Oakland Community College. For each program area, **estimate** the number of both **entry-level hires** and **retraining candidates** for your organization over the **next five years**.

In addition, for each program that fits some of your organization's needs, **suggest the critical topics** that should be covered by that program in order to meet those needs.

---

a) **Computer Equipment Specialist**: Maintain,diagnose and repair computer hardware equipment; install and update computer hardware systems. Emphasis on hardware structure of computers and major peripherals and fault diagnosis; exposure to electronics and programming.

Entry-level hires ____ **Retraining** ____ **Critical topics:**

b) **Mainframe Application Programmer**: Learn the aspects of computer information science applicable to business application design and structured programming. Emphasis on COBOL with exposure to Pascal, PL/1, FORTRAN and Assembler languages in an IBM mainframe environment.

Entry-level hires ____ **Retraining** ____ **Critical topics:**

c) **Office Information Specialist**: Apply end-user desktop computer package programs to the tasks of generating, maintaining and reporting office information. Emphasis on word processing with basic exposure to MS-DOS concepts, spreadsheets and database.

Entry-level hires ____ **Retraining** ____ **Critical topics:**

d) **Small Computer Specialist**: Configure and install desktop computer systems; select computer hardware and package software to fit end-user needs; function as a technical resource for end-user questions. Emphasis on MS-DOS package software; exposure to UNIX, programming and hardware architecture.

Entry-level hires ____ **Retraining** ____ **Critical topics:**

(OVER)

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8) Below are brief descriptions of **possible additions to the computer-related programs** offered by Oakland Community College. For each program area, **estimate** the number of both **entry-level hires and retraining candidates** for your organization over the next **five years**.

In addition, for each program that fits some of your organization's needs, **suggest the critical topics** that should be covered by that program in order to meet those needs.

---

a) **Communications Specialist**: Learn the aspects of computer information science applicable to communication network architecture; become familiar with communication configurations for local area networks of desktop computers linked to mainframes; function as a technical communication resource for end users.

Entry-level hires ____ **Retraining** ____ **Critical topics:**

b) **Data Base / Expert System Specialist**: Learn the aspects of computer information science applicable to data base architecture and artificial intelligence; become familiar with mainframe and small system data base and expert system packages; apply this understanding to the creation, maintenance and retrieval of data base information; function as a technical resource to end users in these areas.

Entry-level hires ____ **Retraining** ____ **Critical topics:**

c) **Project Support Specialist**; Learn the concepts and practices of project scheduling (PERT, CPM *etc*), estimating, accounting control and documentation; provide technical support to project management.

Entry-level hires ____ **Retraining** ____ **Critical topics:**

d) **System Environment Specialist**: Learn the aspects of computer information science applicable to the architecture and operating system software of desktop computers and small time-sharing computer systems; configure and maintain the system environment for such computer systems; function as a technical system environment resource for end users.

Entry-level hires ____ **Retraining** ____ **Critical topics:**

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Mailing label dupe on return →

[redacted]
MANAGER
THE PHOENIX OF SOUTHFIELD IN
313 S MAIN
ROYAL OAK MI 48067

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000
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8e) In the space below, give us your **suggestions for additional computer-related programs** that Oakland Community College could offer that would be useful to your organization. Please **include** entry-level hiring and retraining estimates along with critical topics for each program. Use the back of this page and/or additional sheets if confined by space.

9) Using the scale below, please **assess the importance of basic skills and general education to computer specialist programs**; *i.e.* what education in addition to computer courses do you feel *should* be included in computer specialist programs?

1	2	3	4	5
no importance	small importance	moderate importance	very important	extremely important

___ a) English composition (writing)
___ b) Discrete math (# systems, sets)
___ c) Verbal communication (speech)
___ d) Algebra
___ e) Natural science courses (Chemistry, Biology etc.)
___ f) Social science courses (Psychology, Sociology etc.)
___ g) Humanities courses(Art, Music)
___ h) Business basics
___ i) Accounting basics
___ j) Keyboarding skills
___ k) Professional ethics
___ l) ____________________

10) Your estimate of how many of your organization's employees have taken computer-related courses at Oakland Community College: _________.

11) Briefly describe your perceptions of the quality of the computer-related education offered at **Oakland Community College**:

12) Indicate your interest in participating in the computer education efforts of Oakland **Community College by placing a check next to the following possible roles:**

Employer Advisory Committee Member ______
Co-op training sponsor ____
Other: ______________________________
Adjunct Faculty Member ______
Resource Support ______

Thank you for your participation in this survey. Use the back of this page and/or extra sheets for any additional comments. Please return the survey by June 15 in the enclosed envelope or to:

Dr. Henry Austin, F302
Orchard Ridge Campus, OCC
27055 Orchard Lake Rd.
Farmington Hills, MI 48018
(*phone: 471-7726*)

Appendix E

Report on a review of the computer technology literature

Overview: The bass note to the symphony (or cacophony?) of the rapid computerization of society is the technology of circuit miniturization. This technology enables computers to be made smaller, less expensive and more powerful, all simultaneously. The favorable economy of scale for computers which results from this alchemy drives the increased use of computers as human tools. This burgeoning usage engenders changes in both the individuals and organizations which employ computers, leading to both massive social change and feedback to the content and direction of computer technology (30, 59, 73).

A full examination of the complex interaction between computer technology and human purpose is beyond the scope of this report. The focus for this effort is on the major trend projections for computer technology over the next ten years. However, it is important to note that these trends will be occuring within an interactive context of major social change and feedback. The reader is referred to the eloquent testimony of Toffler, Moshowitz, Evans, Forrester, Zuboff etc. for a more definitive study of the emergence of the information age and its individual, social and cultural ramifications (23, 27, 29, 32, 33, 36, 49, 52, 59, 65, 66, 68, 73, 76).

The four major trends examined in this report are desktop power, networks, open systems and software productivity tools.

Desktop power: A major trend in the evolution of computer technology is the migration of processing power from the mainframe to the desktop. Peled forecasts that the circuit miniturization trends driving this migration will continue for the forseeable future (59). This migration has occurred in the following stages:

1. All processing done by a central mainframe with reports generated for users.
2. Migration of I/O interface processing from the central mainframe to end-user terminals for high-profile applications.
3. Proliferation of this trend to more organizations and applications through mid-range central processors or "minicomputers".
4. Limited full-range processing for end-users through the first generation of personal computers.
5. Extensive processing power rivaling mainframes for elite end-users through expensive second-generation personal workstations (33, 36, 56).

The next stage will be the proliferation of more powerful, less expensive workstations. This is particularly important to the CIS curriculum because application programming is a process-intensive task which will increasingly rely on workstations as the development environment (14).

There is much evidence to support the migration from mainframes to workstations. Perhaps the most compelling is the shift in the percentage of hardware expenditures of the three market segments of mainframe, mini and desktop computer systems over time (10):

Yr	Dsktp	Mini	Mnfrm
85	16	42	42
89	29	38	33
93(prj)	40	34	26

Other sources as well report rapid growth in workstations over the past year and project this to continue in to the 90's (22, 43, 63). Additional evidence for workstation growth is increasing reliance on this technology by systems integrators; those developing software for specialized end-users (34).

An important technical factor in workstation evolution is RISC (reduced instruction set computer) architecture. RISC computers have simpler instruction sets than the CISC (complex instruction set computer) currently in use. RISC computers are less expensive to build, run faster and offer a more stable platform for software development than CICS computers. RISC is projected to become the dominant architecture for workstations in the 90's (38, 62).

The computer environment supporting computer education at OCC has no workstations. They are a necessity for computer education in the 1990's.

Communications: As computer power migrates to the desktop, connecting desktop computers to each other and to shared resources becomes increasingly important. Computer communications is a complex topic, with an arcane vocabulary of transmission protocols and interconnection techniques; a full tutorial is beyond the scope of this report. The major trends outlined below are from Dertouzos (30), Forrester (36), Nilles (56) and v257 of Scientific American (57).

1. Local area networking (LAN) refers to the technology of interconnecting a limited number of computers (typically < 50) which are fairly close to each other, often in the same room or building. The rationale for interconnection is usually the sharing of expensive resources such as laser printers, connections to other networks and mass storage containing applications and data bases. LAN is offered in a wide variety of configurations and network speeds, is a popular solution for office and educational work groups and is projected to continue growing even as more sophisticated networks evolve (41).

2. Evolving trends in network evolution architecture include the construction of 'backbone' networks for interconnecting LAN locations within a site and wide-area networking (WAN) for interconnecting seperate sites. Another trend is the continual widening of the interconnection pipeline to both increase speed of text transmission and enable video as well as text information to be transmitted.
3. The client/server model of distributing applications across a network is another emerging trend in communications architecture. Under this model, client workstations handle the user I/O and primary processing portions of applications. Other client needs, such as exotic or expensive I/O, data base access, communication to other clients and linkage to other networks, are handled by server stations which respond to those requests across the network (70, 72). Client/server networks are projected as the dominant communication architecture of the 90's (35).
4. On-line transaction processing (OLTP) will also continue to grow. The OLTP market is projected to double over the next five years (61). Currently, the market is dominated by IBM mainframes serving time-shared terminals through either CICS (communication interface control system), TSO (timesharing operating system) or TPF (transaction processing facility) communication systems (61). However, networked systems based on UNIX variants are predicted to make significant inroads as this architecture matures (12).

In summary, communication networks are projected to grow in tandem with desktop workstations. As processing power migrates to the desktop, networks emerge as the means for integrating this force with central data bases.

The OCC computer curricula have no facilities for nor coursework in computer network communications. They are required to support a viable program.

Open systems: ...is the term for computer environments which are portable across a wide variety of hardware platforms, can serve as a transparent host to a wide variety of application software and I/O peripherals through adherence to standard protocols, and are expandable across a wide range of capabilities. The antitheses are closed systems, which are limited to a single-vendor hardware platform and are consequently limited to a narrower range of application software, I/O peripherals and capabilities. The open system concept is important to distributed systems of workstations since such systems are a complex of many different hardware platforms and software applications.

The UNIX operating system and its' many variants is emerging as a virtual synonym for open systems, since UNIX is the only computer environment portable across a wide range of hardware platforms. UNIX originated in the research and education sectors, but has become a major force in the business sector in direct proportion to the penetration of distributed workstation networks into the business sector (63). In response to that penetration, the leading hardware vendors have made major committments to UNIX, including IBM (26), Hewlett-Packard (64), DEC (75) and Apple (42), despite the vested interest they each have in their own closed environments. Some question the sincerity of the IBM's UNIX efforts, given its' huge investment in closed system architecture coupled with the recent launch of a major 'semi-open' initiative called SAA (system application architecture) to integrate the entire IBM product line (3).

UNIX is also competing with OS/2, a semi-open initiative from Microsoft for providing a workstation migration path for the legion of users of its' MS-DOS PC product. UNIX appears ahead at this time due to both its' maturity and true open system philosophy (2, 4, 28, 75).

Additional evidence of UNIX importance is the increasing use of UNIX as platform for value-added resellers (VAR) ((71) and the success of the SCO in packaging UNIX for off-shelf delivery to the mass market (37).

The UNIX-based philosophy of open systems has much to offer OCC. Most importantly, UNIX provides a stable platform for protecting applications and courseware against hardware obsolescence. Additional benefits include a wider range of choice for hardware and software, a platform which can evolve with changing computer technology and providing students with an environment of industry-standard conventions. UNIX must play a larger role at OCC than the partial content of one course which is offered currently.

Software productivity tools: The evolution of computer end-users from report readers to workstation users has caused major changes in both the content and development of computer programs. The increase in desktop computers has helped fuel an already burgeoning demand for new software. It is estimated that 80% of application programmer time is spent maintaining existing software, with the demand for new software applications growing at 45% per year (21).

These figures represent a crisis in software engineering. Current strategies for meeting the crisis rely heavily on fourth generation languages such as SQL and Dbase. Emergent strategies attempt to both ease demand for programs by providing users with software tools for direct use of the computer (OOPS: object-oriented programming systems and expert systems) and to increase application development efficiency (OOPS and CASE: computer-assisted system engineering) (21).

Fourth generation languages differ from third generation languages such as COBOL and FORTRAN by acting as front-ends to a data base, which contains the formats and cross-linkages to all of the important data elements. Fourth generation languages also typically contain powerful query and report generation features which automate much of the programming detail. These languages continue to evolve, notably in the direction of distributing applications across networks as discussed in the communications section. They will continue to play an important role in application development (46) and are their practitioners are much in demand (11, 48, 51).

OOPS are a key factor for empowering end-users by providing them an interface with point-and-click selection from a screen containing graphic objects including icons, pop-up menus, dialog boxes and windows. Another basic OOPS interface tenet is that the common features of all applications look the same to the user so that a new command/response vocabulary does not have to be learned for each unique application. The total effect is a much shorter learning curve and higher productivity for the user. OOPS are the direct descendants of the pioneering research on the user/computer interface by the PARC research center at Xerox. OOPS were first implemented on high-end workstations and were successfully introduced to the mass PC market by the Apple Macintosh (69).

As well as empowering end-users, OOPS also improves the efficiency of application development by binding together data structures and procedures into 'objects ' which communicate to each other by sending messages. These objects tend to be generic and reusable in different applications, such that application development becomes a two-stage process of developing objects at one level and selecting and linking objects at a higher level. This practice is more efficient than the custom crafting of procedures and data structures endemic to the use of traditional procedural languages such as COBOL and FORTRAN. Smalltalk, Hypertalk and object-C are examples of object-oriented languages (69). Currently, there exists a large demand for OOPS applications and relatively few OOPS programmers, creating a heavy demand for OOPS programmer training (14, 46).

Expert systems are the latest development in a series of tool software for empowering end-users. Earlier developments included packages for word processing, spreadsheets and data bases. The idea behind expert systems is to encode the knowledge base and reasoning principles used by experts into a program that can then be used by non-experts for both operational and training purposes. Expert systems are a product of artificial intelligence (AI) research in the 1970's which are becoming practical for mass use with the advent of the powerful workstations required to support them. A 50% growth growth in the expert system market is predicted over the next year (39).

The term **CASE** describes a collection of tools for enhancing the efficiency of the application development process. 'Front-end' CASE refers to the tools for designing applications and managing the development process. 'Back-end' CASE refers to the tools for automatically generating programming source code from design specifications. CASE technique requires a substantial investment in tool set-up and programmer training before efficiency savings can be realized. The gains are greatest for large, complex software systems. In 1987, four percent of new software was developed using CASE; this figure is projected to rise to 26% in 1992 (21, 24, 55).

Both the DPR and OIS curricula offer courses in the first-generation user applications of word processing, spreadsheets and data bases on MS-DOS-based PC's. OCC has insufficient depth in fourth generation languages and has no offerings in OOPS, expert systems or CASE. These techniques must be integrated into the computer curricula in order to bring these curricula up to modern standards and practices for both end-user tools and programming methods.

Summary: The review of the computer technology reveals five major trends:

1. The evolution of computer technology is inter-related with major individual and social changes as the industrial age is transformed into the information age.
2. First-generation personal computers are rapidly evolving into more powerful and capable tools called workstations.
3. Communication networks are evolving in tandem with workstations in order to tie work stations to each other, to shared resources and to other networks.
4. Networks are incompatible with closed, vendor-specific hardware platforms. Open system environments based on UNIX are evolving together with communication networks of workstations.

5. Software development is in crisis because of both the huge increase in demand for software and the major changes in software itself arising from the emergence of workstations, networks and open system philosophy. The strategies for meeting this crisis include empowering end-users with better software tools to ease the demand for new software and to improve the efficiency of software development through process control and automated code generation.

The computer curricula of OCC must carefully integrate all of these developments in order to effectively serve both students and the community.

Appendix F

Proposed computer information science curriculum for OCC

CIS
Major Program Revision

The CIS Major Program Revision Consists of the below changes:

A. Replace the current DPR Business Computer Programming option with the new CIS option.

B. Delete the DPR Computer Science Option.

C. Delete the DPR Computer Systems Option.

D. Delete the DPR Small Computer System Option.

E. New CIS Courses

. CIS100	Computer Literacy
. CIS101	Programming Literacy
. CIS104	Introduction to Computing
. CIS105	Computer Applications
. CIS130	Expert Systems/ A.I.
. CIS180	Special Topics
. CIS230	Operating Systems & Architecture
. CIS240.4	CIS Intership

F. Minor Course Revisions

- . CIS106 (DPR106)
- . CIS108 (DPR108)
- . CIS112 (DPR112)
- . CIS115 (DPR115)
- . CIS120 (DPR120)
- . CIS123 (DPR123)
- . CIS125 (DPR125)
- . CIS190 (DPR190)
- . CIS203 (DPR203)
- . CIS205 (DPR205)
- . CIS215 (DPR215)
- . CIS216 (DPR216)
- . CIS245 (DPR245)
- . CIS281 (DPR281)
- . CIS283 (DPR283)

G. Courses Removed From The Program

. DPR220	Computer Programming Assembler II
. DPR253	Quantative Computer Methods
. DPR263	Computer Programming Applications
. DPR280	High Level Languages
. DPR282	Computer Architecture
. DPR285	Small Computer Systems Architecture

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(NEW) COMPUTER INFORMATION SYSTEMS

Major Requirements:

CIS 104	Introduction To Computing	2
CIS 105	Computer Applications	4
CIS 112	Structured Programming I (C)	4
CIS 180	Special Topics	3
CIS 190	Structured Programming II (C)	4
CIS 203	Information Systems	3
CIS 215	Application Development I (COBOL)	4
CIS 230	Operating Systems/Architecture	4
CIS 245	Application Development II(COBOL)	4
CIS 281	Data Structures	4
CIS 283	Data Base/Communications	4

		40

CIS 240.4 CIS Internship - Optional class, based on industry position availability and student qualifications. This class may be taken in addition to the Major Requirements.

Required Supportive Courses:

ACC 111	Proprietorship Accounting	3
or		
ACC 251	Principles of Accounting I	4
BUS 101	Prin. and Prac. of Business	3
*ENG 135	Business Communications	3
or		
*ENG 151	English I	3
*SPE 129	Inter. Comm. for Careers	3
*MAT 115	Intermediate Algebra	4
or		
*MAT 153	Statistics	3

* May be used to meet General Education Requirements.

General Education Requirements:

See graduation requirements for an Associate in Applied Sciences Degree on Page 37.

COMPUTER INFORMATION SYSTEMS

COMPUTER USER Certificate

Major Requirements:

CIS 104	Introduction to Computing	2
CIS 105	Computer Applications	4
CIS 106	Microcomputer Spreadsheet Concepts	3
CIS 108	Microcomputer Database Concepts	3
CIS 112	Structured (C) Programming I	4
CIS 203	Information Systems	3
CIS 205	Small Comp. Application Software	4
CIS 230	Operating Systems/Architecture	4
* 2 CIS Electives		7-8

		34-35 Credits

COMPUTER PROGRAMER Certificate

Major requirements:

CIS 104	Introduction to Computing	2
CIS 105	Computer Applications	4
CIS 112	Structured (C) Programming I	4
CIS 190	Structured (C) Programming II	4
CIS 203	Information Systems	3
CIS 230	Operating Systems/Architecture	4
CIS 281	Data Structures	4
CIS 283	Data Base/Communications	4
* 2 CIS Electives		7-8

		36-37 Credits

* CIS Electives may be chosen from any CIS designated class listed below.

CIS106, CIS108, CIS115, CIS120, CIS123, CIS125, CIS130, CIS180, CIS190, CIS215, CIS216, CIS245, CIS281, CIS283

F-3

OAKLAND COMMUNITY COLLEGE
NEW COURSE (AND REVISION) PROPOSAL FORMAT

1. **Course Title:** Computer Literacy

2. **Proposed Course Number:** CIS100

   Has the Registrar been consulted about the appropriateness of the course number? Yes No X

3. **Number of credits for Course:** 1
   Group Classification (A or B): B
   Contact Hours: 15

4. **Target date for the first offering:** Fall 1990

5. **Catalog description: State the purpose of the course; include prerequisite/corequisite listing; include course fee if applicable; approximately 50-100 words.**

   This course provides a basic understanding of fundamental computer concepts, software, systems and programming. Students will utilize a microcomputer to acquire basic skills in interfacing with software packages. Topics to be covered include word processing, DOS operating system commands, concepts, social responsibilities of computing and programming concepts.

   Course Fee: $20.00
   Prereq: None

6. **Need for the course. (If applicable: attach Advisory Committee documentation; attach needs analysis and/or program review documentation.) Include anticipated additional staff; anticipated capital outlays; if lab fees required specify the amount as "recommended by campus"; LRC materials, supplies (e.g. books, journals).**

   Many students are not prepared to enter into CIS103 or CIS112 without a basic understanding of computers and concepts. This course is designed for those students who would like a basic literacy course in preparation for further CIS Course work. Also, this would be an ideal course for the general College Community to obtain fundamental computer literacy competence.

   Course Fee $20.00

   Students would utilize the computing lab facilities to complete the requirements for the course.

7. **Attach Course Learning Objectives with student performance goals. (Include reading, writing, speaking, listening and critical thinking objectives and goals.)**

F-4

OAKLAND COMMUNITY COLLEGE
NEW COURSE (AND REVISION) PROPOSAL FORMAT

1. **Course Title**: Programming Literacy

2. **Proposed Course Number**: CIS101

   Has the Registrar been consulted about the appropriateness of the course number? Yes No X

3. **Number of credits for Course**: 2
   Group Classification (A or B): B
   Contact Hours: 30

4. **Target date for the first offering**: Fall 1990

5. **Catalog description: State the purpose of the course; include prerequisite/corequisite listing; include course fee if applicable; approximately 50-100 words.**

   This course provides a fundamental introduction to computer programming concepts, design and algorithmic development skills. The student will design algorithms utilizing top down design techniques and develop the analytical skills for program design. Programs will be written on Micro Computers utilizing the above techniques.

   Course Fee: $20.00

6. **Need for the course. (If applicable: attach Advisory Committee documentation; attach needs analysis and/or program review documentation.) Include anticipated additional staff; anticipated capital outlays; if lab fees required specify the amount as "recommended by campus"; LRC materials, supplies (e.g. books, journals).**

   Entering students may not have any computer programming background and need a fundamental literacy class to bring them up to a basic level of awareness. This course would be useful for students who feel that they need a basic introduction to programming prior to taking CIS programming classes.

   Course Fee $20.00
   Prereq: None

7. **Attach Course Learning Objectives with student performance goals. (Include reading, writing, speaking, listening and critical thinking objectives and goals.)**

F-5

OAKLAND COMMUNITY COLLEGE
NEW COURSE (AND REVISION) PROPOSAL FORMAT

1. **Course Title:** Introduction To Computing

2. **Proposed Course Number:** CIS104

   Has the Registrar been consulted about the appropriateness of the course number? Yes No X

3. **Number of credits for Course:** 2
   Group Classification (A or B): A
   Contact Hours: 30

4. **Target date for the first offering:**

5. **Catalog description: State the purpose of the course; include prerequisite/corequisite listing; include course fee if applicable; approximately 50-100 words.**

   This course explores the impact of computer technology on our society and introduces the student to information processing concepts. Topics discussed include types of information systems, components of computer systems, application and system software, computer and communication hardware, a survey of programming languages, the system development cycle, social issues relating to computers, and future directions of computer technology and usage.

   Prereq: None required

6. **Need for the course. (If applicable: attach Advisory Committee documentation; attach needs analysis and/or program review documentation.) Include anticipated additional staff; anticipated capital outlays; if lab fees required specify the amount as "recommended by campus"; LRC materials, supplies (e.g. books, journals).**

   It is important that today's student be aware of the basic concepts involving computers, their impact on society and the issues they raise, as well as understanding the various tasks which computers are now and will be performing. A knowledge of the basic hardware and software components of computer systems is essential.

7. **Attach Course Learning Objectives with student performance goals. (Include reading, writing, speaking, listening and critical thinking objectives and goals.)**

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OAKLAND COMMUNITY COLLEGE
NEW COURSE (AND REVISION) PROPOSAL FORMAT

1. **Course Title:** Computer Applications

2. **Proposed Course Number:** CIS105

   Has the Registrar been consulted about the appropriateness of the course number? **Yes** **No X**

3. **Number of credits for Course:** 4
   Group Classification (A or B): B
   Contact Hours: 60

4. **Target date for the first offering:**

5. **Catalog description: State the purpose of the course; include prerequisite/corequisite listing; include course fee if applicable; approximately 50-100 words.**

   This course introduces the student to the essentials of microcomputer usage. The student will explore, utilize, and and gain application skills with software products such as business graphics, communications, spreadsheets, databases, and word processing. Emphasis is place on software integration and practicum instruction.

   Prereq: CIS100 suggested for students will no previous microcomputer exposure.

   Course Fee: $20.00

6. **Need for the course. (If applicable: attach Advisory Committee documentation; attach needs analysis and/or program review documentation.) Include anticipated additional staff; anticipated capital outlays; if lab fees required specify the amount as "recommended by campus"; LRC materials, supplies (e.g. books, journals).**

   Today's student must learn to use computer technology effectively to aid in schoolwork and eventually in a career. Obtaining basic usage skills in a variety of application areas is critical in the business workplace of today. Traditional computer concept classes do not have the time to develop minimal skill and comprehension levels in these areas.

7. **Attach Course Learning Objectives with student performance goals. (Include reading, writing, speaking, listening and critical thinking objectives and goals.)**

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OAKLAND COMMUNITY COLLEGE
NEW COURSE (AND REVISION) PROPOSAL FORMAT

1. **Course Title:** Expert Systems / A.I.

2. **Proposed Course Number:** CIS130

   Has the Registrar been consulted about the appropriateness of the course number? Yes X **No**

3. **Number of credits for Course:** 4
   Group Classification (A or B): B
   Contact Hours: 60

4. **Target date for the first offering:** Fall 1990

5. **Catalog description: State the purpose of the course; include prerequisite/corequisite listing; include course fee if applicable; approximately 50-100 words.**

   The student will investigate the use of Expert System shells in the development of Expert Systems and Knowledge Based Systems. Concepts of Knowledge Engineering, forward and backward reference chaining, object oriented systems, and rule based systems will be presented.

   Course Fee $20.00

   Prerequisite: CIS105 or consent of instructor

6. **Need for the course. (If applicable: attach Advisory Committee documentation; attach needs analysis and/or program review documentation.) Include anticipated additional staff; anticipated capital outlays; if lab fees required specify the amount as "recommended by campus"; LRC materials, supplies (e.g. books, journals).**

   This course will be an elective course for CIS students and will address the needs of local industry and computing professionals who need training in this growing area of computer application.

   Course Fee $20.00

   Students will utilize the computing facilities to develop, test and implement Expert Systems.

7. **Attach Course Learning Objectives with student performance goals. (Include reading, writing, speaking, listening and critical thinking objectives and goals.)**

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OAKLAND COMMUNITY COLLEGE
NEW COURSE (AND REVISION) PROPOSAL FORMAT

1. **Course Title:** Special Topics

2. **Proposed Course Number:** CIS180

   Has the Registrar been consulted about the appropriateness of the course number? Yes x No

3. **Number of credits for Course:** 3
   Group Classification (A or B): B
   Contact Hours: 45

4. **Target date for the first offering:** Fall 1990

5. **Catalog description: State the purpose of the course; include prerequisite/corequisite listing; include course fee if applicable; approximately 50-100 words.**

   This course will explore a particular current topic in Data Processing , Programming, Computer Science or Systems that is relevant in today's environment. Such topics may be Languages (ADA, LISP, 4Th generation tools, APL, etc.), issues (Computer Security, Structured Design, RISC Technology, C.A.S.E. tools, etc.). See schedule of classes for this term's topic.

   Prereq: DPR105 and DPR112
   Course Fee $20.00

6. **Need for the course. (If applicable: attach Advisory Committee documentation; attach needs analysis and/or program review documentation.) Include anticipated additional staff; anticipated capital outlays; if lab fees required specify the amount as "recommended by campus"; LRC materials, supplies (e.g. books, journals).**

   This course will allow the discipline to address issues or topics that are current in nature but perhaps transitory in duration. The ability to provide instruction on current technology and issues is extremely important in an area where the technology changes so quickly.

   Course Fee $20.00

7. **Attach Course Learning Objectives with student performance goals. (Include reading, writing, speaking, listening and critical thinking objectives and goals.)**

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OAKLAND COMMUNITY COLLEGE
NEW COURSE (AND REVISION) PROPOSAL FORMAT

1. **Course Title:** Operating Systems & Architecture

2. **Proposed Course Number:** CIS230

   Has the Registrar been consulted about the appropriateness of the course number? Yes X No

3. **Number of credits for Course:** 4
   Group Classification (A or B): B
   Contact Hours: 60

4. **Target date for the first offering:** Fall 1990

5. **Catalog description: State the purpose of the course; include prerequisite/corequisite listing; include course fee if applicable; approximately 50-100 words.**

   Prereq: CIS190

   This course investigates the concepts and theory involved with computer operating systems. Systems to be explored include UNIX and other operating system environments. Topics will include process management, scheduling, concurrent processes, device management, memory management, virtual memory, and general concepts.

   Course Fee: $20.00

6. **Need for the course. (If applicable: attach Advisory Committee documentation; attach needs analysis and/or program review documentation.) Include anticipated additional staff; anticipated capital outlays; if lab fees required specify the amount as "recommended by campus"; LRC materials, supplies (e.g. books, journals).**

   This course addresses an area omitted from the previous curriculum and is required in the new program.

   Course Fee: $20.00

7. **Attach Course Learning Objectives with student performance goals. (Include reading, writing, speaking, listening and critical thinking objectives and goals.)**

F-10

OAKLAND COMMUNITY COLLEGE
NEW COURSE (AND REVISION) PROPOSAL FORMAT

1. **Course Title:** CIS Internship

2. **Proposed Course Number:** CIS240.4

   Has the Registrar been consulted about the appropriateness of the course number? Yes No X

3. **Number of credits for Course:** 4
   Group Classification (A or B): B
   Contact Hours: 180 hours of supervised work experience.

4. **Target date for the first offering:** Spring 1990

5. **Catalog description: State the purpose of the course; include prerequisite/corequisite listing; include course fee if applicable; approximately 50-100 words.**

   The Internship student will be employed in a position in industry that relates to specific career goals. Student will work a min. of 20 hours per week at an employers site. Entrance into the Internship course will be on a limited basis depending upon industry positions available. The department must approve the worksite prior to enrollment.

   Prerequisite: Student must have completed 19 CIS credit hours from the CIS Core Classes and have written approval of the instructor.

6. **Need for the course. (If applicable: attach Advisory Committee documentation; attach needs analysis and/or program review documentation.) Include anticipated additional staff; anticipated capital outlays; if lab fees required specify the amount as "recommended by campus"; LRC materials, supplies (e.g. books, journals).**

   1. To provide the student with practical on the job work experience.

   2. This class will increase the employability of our graduates and is something the students have desired for many years.

   3. No Course Fee Required.

7. **Attach Course Learning Objectives with student performance goals. (Include reading, writing, speaking, listening and critical thinking objectives and goals.)**

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Appendix G

Proposed support system for the OCC CIS curriculum

(IN PROGRESS - FUNCTIONAL SPECS BEING WRITTEN 11/1/89)

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